



**Quality Assurance Program Plan
for the
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation**

Prepared by:

**Office of Environmental Remediation
601 57th Street, SE
Charleston, WV 25304**

September 2011

This document has been designated a “CONTROLLED DOCUMENT” by Daniel T. Arnold, Quality Assurance Manager, WV DEP. To ensure the current version, contact Mr. Arnold via email at Daniel.T.Arnold@wv.gov. If an updated revision has been issued, instructions for obtaining the updated document will be provided. Notification will be sent if the revision cited is not current. When printed, this document becomes “UNCONTROLLED”.

RECEIVED

OCT 20 2011

DIVISION OF LAND RESTORATION
FRENCH CREEK OFFICE

CONTROLLED DOCUMENT
WVDEP-DLR-OER--001
Revision number: 4
Effective Date: September 20, 2011
Page 3 of 191

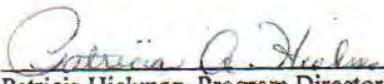
**Quality Assurance Program Plan
for the
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation**

Signature/Approval Page

Approved by:


Donald Martin, Assistant Director


10/11/11
Date


Patricia Hickman, Program Director

10-13-11
Date


Bin Schmitz, Quality Assurance Manager

10/17/2011
Date


EPA Project Manager

10-13-2011
Date

**Quality Assurance Program Plan
for the
West Virginia Department of Environmental Protection
Office of Environmental Remediation**

Table of Contents

<u>Title</u>	<u>Page</u>
Cover Page	1
Document Designation Page	2
Signature/Approval Page	3
Table of Contents	4
Figures, Tables, and Appendices	6
Distribution List	7
Acronyms and Definitions	8
1.0 Introduction	11
1.1 LUST Program	11
1.2 Uniform Environmental Covenant Act	11
1.3 Voluntary Remediation Program	12
2.0 Program Management	12
2.1 Program Organization and Responsibility	12
2.1.1 DLR Director/Assistant Director/OER Program Manager	12
2.1.2 OER Project Managers	13
2.1.3 Contract Specialist	13
2.1.4 OER Quality Assurance Manager	13
2.1.5 Division of Waste Management, QA Program Manager	14
2.1.6 Licensed Remediation Specialists	14
2.1.7 Contractors, Subcontractors, and Consultants	14
2.1.8 Data Reviewers/Data Validators	15
2.2 Program Strategy	15
2.3 Quality Objectives and Criteria for Measurement Data	16
2.4 Action Levels	19
2.5 Special Training/Certification	20
2.5.1 OER Personnel and On-site Contractors	20
2.5.2 Analytical Laboratory Personnel	21
3.0 Data Generation and Acquisition	21
3.1 Sampling Methods Requirements	21
3.2 Sample Handling and Custody Requirements	24
3.3 Analytical Methods Requirements	26

Table of Contents

<u>Title</u>	<u>Page</u>
3.4 Quality Control Requirements	27
3.4.1 Field Activities	27
3.4.2 Laboratory Activities	28
3.5 Instrument/Equipment Maintenance Requirements	28
3.5.1 Field Equipment	28
3.5.2 Laboratory Equipment	29
3.6 Instrument Calibration and Frequency	29
3.6.1 Field Equipment	29
3.6.2 Laboratory Equipment	29
3.7 Data Management	29
3.7.1 Sample Documentation	29
3.7.2 Field Logbook	30
3.7.3 Standard Operating Procedures	30
3.7.4 Field Data Records	30
3.7.5 Analytical Data Deliverable Requirements	30
3.7.6 Data Management Procedures	32
3.8 Data Acquisition Requirements for Non-Direct Measurements	33
4.0 Assessment and Oversight	33
4.1 Performance and System Audits	34
4.1.1 Field Activities	34
4.1.2 Laboratory Activities	35
4.2 Reports to Management	35
4.3 Corrective Action	36
4.3.1 Field Activities	36
4.3.2 Laboratory Activities	36
4.4 Dispute Resolution	37
5.0 Data Validation and Usability	37
5.1 Data Review	37
5.2 Data Validation	37
5.2.1 Voluntary Remediation Program and the UECA Pathway	38
5.2.2 LUST Program	39
5.2.3 Waste Characterization	39
5.3 Reconciliation with User Requirements	39
5.3.1 Precision	40
5.3.2 Accuracy	40
5.3.3 Representativeness	40
5.3.4 Completeness	41
5.3.5 Comparability	42
5.3.6 Sensitivity	42

Table of Contents

<u>Title</u>	<u>Page</u>
5.4 Statistical Measurements	42
5.4.1 Measurements of Central Tendency	43
5.4.2 Measurement of Dispersion	43
6.0 References	45

FIGURES

- Figure 1: Organizational Chart
- Figure 2: Chain-of-Custody Form
- Figure 3: Example Custody Seals and Sample Container Labels

TABLES

- Table 1: Sampling Strategies
- Table 2: Sample Containers, Preservation and Holding Times
- Table 3: Field Quality Control Requirements
- Table 4: Preventive Maintenance - Field Equipment
- Table 5: Calibration and Corrective Action - Field Equipment
- Table 6: Data Evaluation

APPENDICES

- Appendix A: Typical List of Chemicals of Concern
- Appendix B: Standard Operating Procedures
- Appendix C: Laboratory Rules (Title 47, Series 32)
- Appendix D: OER Inspection Forms and Checklists

DISTRIBUTION LIST

Secretary – Department of Environmental Protection

Director and Assistant Directors – Division of Land Restoration

Project Managers – Office of Environmental Remediation

EPA Program Manager

Acronyms and Definitions

BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAGD	Corrective Action Plan Guidance
CLP	Contract Laboratory Program
CSM	Conceptual Site Model
DRO	Diesel Range Organics
DLR	Division of Land Restoration
DOT	Department of Transportation
DQOs	Data Quality Objectives
EDD	Electronic Data Deliverables
EOI	Expression of Interest
EPA	Environmental Protection Agency
EQulS	Environmental Quality Information Systems
ERIS	Environmental Resource Information System
GRO	Gasoline Range Organics
HAZWOPER	Hazardous Waste Operations and Emergency Response
IATA	International Air Transport Association
LRS	Licensed Remediation Specialist
LUST	Leaking Underground Storage Tank
MDL	Method Detection Limit
MS/MSD	Matrix Spike/ Matrix Spike Duplicate
MTBE	Methyl Tertiary Butyl Ether
OER	Office of Environmental Remediation

ORO	Oil Range Organics
PAH	Polynuclear Aromatic Hydrocarbons
PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity
PCBs	Polychlorinated Biphenyls
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
QAM	Quality Assurance Manager
QAP	Quality Assurance Plan
QA/QC	Quality Assurance/Quality Control
RFQ	Request For Quotes
% R	Percent Recovery
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SOPs	Standard Operating Procedures
SVOCs	Semi-Volatile Organic Compounds
SW-846	Refers to the EPA publication entitled <i>Test Methods for Evaluating Solid Waste, Physical/Chemical Methods</i>
TAGIS	Technical Applications and Geographic Information System
TBA	Tertiary Butyl Alcohol
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbons
UECA	Uniform Environmental Covenant Act
VOCs	Volatile Organic Compounds

VRP	Voluntary Remediation Program
VRRA	Voluntary Remediation and Redevelopment Act
WVDEP	West Virginia Department of Environmental Protection

**Quality Assurance Program Plan
for the
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation**

1.0 INTRODUCTION

This Quality Assurance Program Plan is intended for use by the West Virginia Department of Environmental Protection (WVDEP), Division of Land Restoration (DLR), Office of Environmental Remediation (OER). The Office of Environmental Remediation administers multiple cleanup programs including leaking underground storage tanks (LUST), brownfields, and voluntary remediation. The relevant statutes for these programs are Chapter 22 Article 17, the Underground Storage Tank Act, Chapter 22 Article 22B, the Uniform Environmental Covenant Act, and Chapter 22 Article 22, the Voluntary Remediation and Redevelopment Act, and the rules promulgated to enforce each act. The primary beneficiaries of this plan will be the project management staff and emergency response staff while other programs will be aided and protected by the consistency and quality assured by this plan. At a minimum, the QAPP will be reviewed and updated, as necessary, every three years.

1.1 LUST Program

The LUST Program provides oversight of the cleanup of releases of regulated substances (primarily petroleum products) from leaking underground storage tanks and piping, overfills, and spills. Owners and operators of regulated UST systems may choose to clean-up releases by following the traditional standard enforcement path, seeking closure under the Uniform Environmental Covenant Act (UECA), or they may choose to make application to the Voluntary Remediation Program (VRP). The traditional approach utilizes specific numerical standards for soil and groundwater clean-up levels as defined in the Corrective Action Plan Guidance Document (CAGD). The LUST Program also administers the federal and state LUST Response Funds that are used for state-lead investigations and clean-ups, when the State takes the lead at sites where an emergency exists, the responsible party does not have the financial means to respond to the release, or in those circumstances where the responsible party refuses to comply with the requirements. Data is collected under this program to delineate the extent of contamination from LUST sites and to formulate corrective action plans, which result in the subsequent closure of the sites once numerical clean-up standards have been reached. The UECA and VRP pathways utilize risk based standards in order to reach closure.

1.2 Uniform Environmental Covenant Act

The Uniform Environment Covenant Act (UECA) was enacted by the West Virginia (WV) Legislature as a means for encouraging the voluntary clean-up of contaminated sites and

redevelopment of abandoned and/or under-utilized properties. The UECA utilizes risk-based remediation standards as outlined in the Voluntary Remediation and Redevelopment Act Guidance Document. Data is collected under the program to delineate the extent of contamination from sites and to formulate remedial actions utilizing risk based standards.

In the LUST-UECA pathway to closure for LUST sties, responsible parties may choose to remediate the site to risk-based standards for only the contaminants associated with the petroleum release by entering into a LUST-UECA agreement with the agency utilizing the UECA. Once the remediation standards are achieved, the owner will receive a "No Further Action at this time" which amounts to a closure of the leak case similar to what is achieved by following the "traditional path", but which will also require an environmental covenant with restrictions to be recorded to appropriately control the risks/exposures to achieve the remediation standards.

1.3 Voluntary Remediation Program

The Voluntary Remediation and Redevelopment Act (VRRRA) was enacted by the West Virginia Legislature for the purpose of encouraging the voluntary clean-up of contaminated sites and redevelopment of abandoned and under-utilized properties. The VRRRA encourages voluntary remediation and redevelopment through an administrative program set out in the WV Code of State Regulations, Title 60, Series 3 entitled the Voluntary Remediation and Redevelopment Rule (the Rule), which became effective on July 1, 1997. A "Brownfield Applicant" is a special case of voluntary remediation. While Brownfield sites are industrial or commercial properties that are abandoned or inactive, under the West Virginia Voluntary Remediation and Redevelopment Act, a "Brownfield Applicant" involves the use of public funds for the site assessment or remediation. Because of the use of public funds, a much higher degree of public involvement is required for "Brownfield Applicant" clean-ups. The VRP utilizes risk-based remediation standards as outlined in the Voluntary Remediation and Redevelopment Act Guidance Document. Data is collected under the Voluntary Remediation program to delineate the extent of contamination from sites and to formulate remedial actions utilizing risk based standards.

2.0 PROGRAM MANAGEMENT

2.1 Program Organization and Responsibility

The organizational chart provided in *Figure 1* identifies the individuals responsible for the following positions and provides sufficient evidence of the lines of authority for all referenced organizations that are appropriate to accomplish the quality assurance (QA) objectives of OER. Certain individuals may be responsible for more than one function.

2.1.1 DLR Director/Assistant Director/OER Program Manager

The DLR Director and two assistant directors oversee three offices under the Division of Land Restoration. One Assistant Director oversees the Office of Environmental Remediation (OER),

and a second Assistant Director oversees the Abandoned Mine Lands (AML), and Special Reclamation offices. The Director and Assistant Director for OER are responsible for the administration of all facets of the multiple cleanup programs conducted under the Office of Environmental Remediation which include voluntary remediation and Brownfield sites, leaking underground storage tanks, hazardous waste, landfill closure assistance, and pollution prevention and open dump. In addition, there is a Program Manager who manages daily operations for the LUST, Voluntary and Brownfields cleanup programs. The Program Manager supervises the OER Project Managers.

2.1.2 OER Project Managers

OER Project Managers perform various functions associated with the projects that they manage. Depending upon the program managed and the specific situation for a given site, an OER Project Manager may perform duties including, but not limited to: prioritization of sites, sampling, selection of laboratories for sample analysis, obtaining rights-of-entry, overseeing remedial actions at sites, selection and management of contractors, and implementation of the Quality Assurance Program Plan (QAPP). Also, OER Project Managers are responsible for the review and approval of all data and documents generated at the sites they manage.

2.1.3 Contract Specialist

The Contract Specialist has overall fiscal responsibility for the programs administered under OER. The Contract Specialist's duties include, but are not limited to: selection of consultants and/or contractors to perform environmental site assessments and other environmental type work at Leaking Underground Storage Tank sites, Superfund sites, Voluntary Remediation sites and Landfill Closure Assistance Program (LCAP) sites. The selection is made by using a Best Value Procurement tool such as Expression of Interests (EOIs) for selection of architectural & engineering services. Work also involves purchasing equipment, material and other supplies for the OER by using the competitive bidding process such as Request for Quotes (RFQs) and ensuring that contracts are in place with laboratories and other vendors and are updated as needed.

2.1.4 OER Quality Assurance Manager

The OER Quality Assurance Manager (QAM) has direct responsibility for assessing quality assurance/quality control (QA/QC) performance and determining if QA/QC objectives are being met, recommending corrective actions, and keeping the Project Managers informed of relevant QA/QC information. The QAM is independent of the data generators (i.e. laboratories and contractors); however, the DLR QAM may have some duties that result in the generation of data. In accordance with Section 1.1.5 of the WVDEP Quality Management Plan, when a situation arises where there may be a conflict of interest between the Quality Assurance Manager (QAM) in a Division and the review of that Division's activities, a QAM from a different Division will be called upon to review the circumstance as it pertains to Quality Assurance. All issues and decisions regarding the Quality Assurance Program Plan should be made by the OER QAM in consultation with the OER Project Management, the West Virginia Department of

Environmental Protection (WVDEP) Quality Management Team, and the Environmental Protection Agency (EPA) Region III, as appropriate.

2.1.5 Division of Water and Waste Management, QA Program Manager

The Division of Water and Waste Management Quality Assurance Program is responsible for certifying environmental laboratories in order to ensure that all divisions of the WVDEP receive accurate and reliable analytical data. Laboratories are certified when they follow approved methods, employ well-trained capable staff, and use equipment and instrumentation suited to the work they perform. A laboratory's certification may be revoked if the laboratory commits any falsification relating to certification, testing, or reporting of analytical results or for failing to meet the proficiency testing requirements. Quality Assurance personnel provide laboratory certification services to all divisions of WVDEP. In addition, the certification program is open to any U.S. laboratory seeking to provide data to the WVDEP.

2.1.6 Licensed Remediation Specialists

Under the Voluntary Remediation and Redevelopment Act (VRRRA), Licensed Remediation Specialists (LRS) are required to supervise activities during clean-ups pursuant to the Act. The applicant entering the voluntary program selects the LRS of their choice, but the LRS must meet certain minimum requirements as set out in VRRRA. All candidates for licensing have minimum education requirements, documented experience in remediation, and must demonstrate practical knowledge about environmental regulations, site investigations, health and safety protocol, quality assurance, and remedial design. This practical knowledge must be demonstrated by passing an examination given by the WVDEP.

2.1.7 Contractors, Subcontractors and Consultants

In general, the responsible parties that are being regulated hire the contractors and consultants; however, there are instances where the OER finds it necessary to hire contractors and consultants. OER follows State established practices when hiring contractors and/or consultants. In general, the contractors/consultants are selected based upon their qualifications through the expression of interest process and then costs are negotiated. Contractors/consultants may be hired by OER to perform a wide range of services such as, but not limited to: performing simple sampling events, laboratory analysis, underground storage tank removal, disposal of waste, site investigations, and designing/installing remediation systems.

Depending upon the scope of work to be performed, a contractor may hire subcontractors to perform work for them. The contractors are responsible for the selection of subcontractors and in cases where the contractor was hired by OER, OER must grant approval for the use of the subcontractor. It is the responsibility of the primary contractor to train the subcontractors and to ensure their compliance with the provisions of the QAPP and all other project related plans.

The contractor and any subcontractors are required to be clearly identified in site-specific plans generated for OER projects. The main contractor's site Project Manager will be responsible for

maintaining communications with the OER Project Manager. Communication procedures between the contractor's personnel, subcontractors, and OER shall be addressed in the site-specific Sampling and Analysis Plan. The contractor's site Project Manager will be required to notify the OER Project Manager in advance, one week minimum, of all field activities so that the OER Project Manager may perform oversight procedures in accordance with Section 4.1.1 of this QAPP.

2.1.8 Data Reviewers/Data Validators

Personnel at the WVDEP certified laboratory performing the sample analyses generally perform laboratory data review. The contractor/consultant, LRS, and/or OER Project Manager may also perform data review activities to determine whether the data is of acceptable quality.

Data validation includes assessment of the whole raw data package from the laboratory. It requires that the techniques utilized be applied to the body of the data in a systematic and uniform manner. Standard EPA protocols for validation (e.g. Contract Laboratory Program (CLP) protocol or SW-846) should be used. For data validation purposes, the analytical laboratory should be required to generate documentation equivalent to a full CLP deliverables package for the Voluntary Remediation Program. With respect to samples collected for the LUST program (traditional pathway) or samples collected for waste characterization purposes, documentation equivalent to a full CLP deliverable package is generally not warranted, unless the responsible party intends to bring the LUST site into the Voluntary Remediation Program or will seek closure under UECA. Consultants, contractors, or subcontractors may perform third party data validation as long as the data validator is not affiliated in any way with the analytical laboratory that produced the data. Furthermore, the data validator cannot have been involved in the collection of data for the project. A data validator should be a person who is knowledgeable of chemistry and has an understanding of analytical methods and laboratory instrumentation. A degree in chemistry or a related physical science with training in laboratory instrumentation, analytical procedures, and general laboratory operations is appropriate and is recommended. Refer to Section 5.2 for a discussion of data validation requirements.

2.2 Program Strategy

Quality Assurance is a system of management activities that involves planning, implementation, assessment, reporting, and quality improvement. OER strives to ensure that the information collected for environmental projects (whether collected by our office or by Contractors) will allow us to make informed, defensible decisions.

The purpose of the Quality Assurance Program Plan (QAPP) is to serve as a guidance document describing how OER will identify the type and quality of the environmental data needed for the various programs that the office administers. OER will utilize the Data Quality Objectives (DQOs) Process to identify the type and quality of environmental data needed for our projects. DQOs are qualitative and quantitative statements that allow the user to:

- ✓ Clarify the intended use of the data to be collected,

- ✓ Define the type of data needed to support the decision,
- ✓ Identify the conditions under which the required data should be collected, and
- ✓ Specify the acceptable limits on the probability of making a decision error based on uncertainty in the data.

The seven steps of the DQO are used during the planning of projects to ensure that field activities, data collection operations, and the resulting data meet the project objectives. A summary of the DQO Process is provided below:

Step 1 – State the Problem – *The project will be concisely summarized, with prior studies and existing information reviewed.*

Step 2 – Identify the Decision – *Determine the available options under consideration and identify the decision(s) that need to be made based on the environmental data collected.*

Step 3 – Identify Inputs to the Decision – *Identify the information that is needed to make informed, defensible decision(s).*

Step 4 – Define the Boundaries of the Study – *The time periods and area of study will be identified, including when and where data will be collected. Also, budgetary constraints of the project will be identified.*

Step 5 – Develop a Decision Rule – *The specific action levels and parameters of interest will be defined and integrated with the previous DQO outputs to describe a logical basis for choosing an appropriate action based on the results.*

Step 6 – Specify Limits on Decision Errors – *An estimate of how much uncertainty in the data that is acceptable will be determined. The acceptable decision error rate will be based on the possible consequences of making an incorrect decision.*

Step 7 – Optimize the Design for Obtaining Data – *The information from the previous steps will be evaluated to generate alternative data collection designs to meet and satisfy the DQOs in the most efficient and cost-effective manner while ensuring that the resulting data meets the project objectives.*

2.3 Quality Objectives and Criteria for Measurement Data

DQOs are qualitative and quantitative statements, which specify the quality of environmental monitoring data required to support decisions. DQOs are predicated in accordance with the anticipated end uses of the data being collected. DQOs are applicable to phases and aspects of the data collection process including site investigation, design, construction, and remedy operations. It is important to note that the level of detail and data quality may vary with the intended use of the data. Prior to all environmental measurement activities, site-specific DQOs and measurement performance criteria will be determined. All measurements will be made so that results are reflective of the medium and conditions being measured. QA/QC samples

generally applicable to OER's programs include the collection of field duplicate samples, equipment rinsate, and trip blanks. At the discretion of WVDEP, the collection of split samples may also be performed at a frequency of 10 percent. In the context of quality control (QC), samples such as duplicates, splits, equipment rinsate, and trip blanks are utilized to aid in the evaluation of measurement error. The data validation report provided for any given project should evaluate all QC elements including data from these samples. The data validation level shall be matched to the intended use of the data and may differ with specific projects as described in the project specific Sampling and Analysis Plan (SAP). Where sample results are being used for risk-based evaluations conducted utilizing Brownfield Targeted grant moneys for assessments in support of redevelopment of Brownfields sites, 100% of the analytical data should be validated. The minimum acceptable level of data validation for risk based closure is validation to the M2 (organics) and IM1 (inorganics) levels. Refer to Section 5.2 for a discussion of data validation requirements.

The DQO Process will be used by OER in data collection activities; however, a graded approach will be used when performing the following activities:

- ✓ Emergency response activities where timely decisions must be made to protect public health or the environment, and/or
- ✓ Compliance or enforcement activities where waste constituent knowledge must be obtained on short notice or in circumstances where safety or time is of the essence.

In situations where an imminent threat to public health and/or the environment exists, the seven steps of the DQO process may be modified, as necessary, to ensure that useable data is acquired while not impeding the agency's response in protecting public health or the environment. The modifications to the DQO process may include, but are not limited, to the following:

- ✓ The DQO process may be less formal (verbally outlined as opposed to written), at least initially to allow quick implementation of activities as needed.
- ✓ The DQO process may not require higher levels of validation due to the need for quick turnarounds.
- ✓ Meeting the action levels described in Section 2.4 of this QAPP may not initially be a concern if there is an immediate public safety and health threat.
- ✓ An initial response may not include all boundaries of a study area, but may be limited initially to potential areas affecting public safety and health.
- ✓ Budgetary constraints may or may not be considered in emergencies.
- ✓ The amount of decision error initially accepted may be higher than normally accepted for environmental issues if it is protective of the public safety and health.
- ✓ The optimization of the data collection design in order to obtain data in the most efficient and cost effective manner may not be an issue when dealing with emergencies and other public safety issues.

Data collected by OER will be used to:

- ✓ Identify the nature and extent of the contamination, and/or

- ✓ Determine treatment and disposal options, and/or
- ✓ Characterize soil and groundwater for on-site or off-site treatment, and/or
- ✓ Collect data to perform risk assessments, and/or
- ✓ Review data presented in risk assessments, and/or
- ✓ Collect data to formulate remediation strategies, and/or
- ✓ Review and approve the use of remedial strategies, and/or
- ✓ Evaluate the effectiveness of remedial actions, and/or
- ✓ Verify attainment of clean-up goals or determine if additional remediation is required.

Data Quality Objectives are typically assessed by evaluating Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity (PARCCS) of all aspects of the data collection process. PARCCS is defined as:

- ✓ Precision: This is a measure of the degree of reproducibility of an analytical value and it is used as a check of the quality of the sampling and analytical procedures. Precision is determined by analyzing replicate samples. QC samples (duplicate samples) may be collected in the field for a project in order to show precision.
- ✓ Accuracy: This is the degree to which a measurement agrees with the actual value. The accuracy of an analytical procedure is determined by addition of a known amount of spike standard to a field sample matrix or a laboratory control matrix.
- ✓ Representativeness: Representativeness expresses the degree to which sample data accurately and precisely represents actual conditions. It is a qualitative determination. The representativeness objective when developing the sampling plan is to eliminate conditions that may result in non-representative data being collected. Maintaining sample integrity is of the utmost importance.
- ✓ Completeness: Completeness is a measure of the amount of the data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. The minimum level of completeness expected is 95% for each analytical method requested. This level is met in the laboratory by ensuring proper sample extraction procedures. This level is met in the field by collecting enough sample that the laboratory has an ample amount in case they need to reanalyze the sample.
- ✓ Comparability: Comparability is the confidence with which one data set can be compared with another. When traceable standards and standard methodology are used, the analytical results can be compared to other laboratories with similar operating procedures. QA samples (split samples sent to a second laboratory) are sometimes collected to show comparability.

- ✓ Sensitivity Sensitivity is defined by the method detection limits (MDLs). The achievement of MDLs depends upon the instrument sensitivity to ensure data quality through on-going checks on instrument performance. The MDL is defined as the minimum concentration that can be measured with 99 percent confidence that the concentration is above zero. Unless otherwise specified in the project specific work plans, the analytical results are compared against the laboratory MDLs.

To assess if environmental monitoring measurements are of an appropriate quality, the general PARCCS requirements found in Section 5.3 of this document for precision, accuracy and completeness will be compared to the site-specific quality objectives and measurement performance criteria.

2.4 Action Levels

In order to determine if there is a potential risk to human health and/or the environment at a site, the contaminants known to be present or potentially present at a site will be assessed. Refer to Appendix A for a typical list of the chemicals of concern and their associated action levels for LUST sites, the De Minimis levels for the Voluntary Remediation Program (Table 60-3B) updated July 2008, and the Draft Supplemental Guidance on Total Petroleum Hydrocarbons (TPH) for voluntary sites. Contaminant concentrations focusing on human health will be compared to the following action levels by media:

- ✓ Soil Current LUST guidelines as defined in the *Corrective Action Plan Guidance Document (CAGD)*

Current guidelines as defined in Table 60-3B of the West Virginia Code of State Regulations (CSR) Title 60, Series 3, *The Voluntary Remediation and Redevelopment Rule*, and the *Draft Supplemental Guidance on TPH*
- ✓ Sediment Current guidelines for the development of Uniform Risk-Based Standards for Surface Soils/Sediments as defined West Virginia CSR Title 60, Series 3, *The Voluntary Remediation & Redevelopment Rule*
- ✓ Groundwater Current guidelines as defined in West Virginia CSR Title 47, Series 12, *The Requirements Governing Groundwater Standards*

Current guidelines as defined in Table 60-3B of the West Virginia CSR Title 60, Series 3, *The Voluntary Remediation and Redevelopment Rule*
- ✓ Surface Water Current EPA National Recommended Water Quality Criteria and West Virginia CSR Title 47, Series 2, *Requirements Governing Water Quality Standards*

For ecological receptors, surface water standards (WV CSR 47, Series 2) will be utilized as action levels. Also, the guidelines by *USEPA Region III Biological Technical Assistance Group (BTAG)* for surface water and sediments may be utilized as screening level values, where applicable. Refer to <http://www.epa.gov/reg3hwmd/risk/eco/index.htm> for the guidelines. With regard to soil benchmarks, there are several potential databases that may be applicable, depending on which receptors are relevant. Separate screening values for wildlife, terrestrial plants, and soil invertebrates are available from the U. S. Department of Energy, Oak Ridge National Laboratories at: http://www.esd.ornl.gov/programs/ecorisk/benchmark_reports.html.

2.5 Special Training/Certification

2.5.1 OER Personnel and On-site Contractors

Specialized training or certification requirements may be necessary for performing work at a given project location. As appropriate, OER personnel and Contractors performing work at project locations will have specialized training. Specialized training/certification may include, but is not limited to, the following:

- ✓ Safety training such as Hazardous Waste Operations and Emergency Response (HAZWOPER) training, and/or
- ✓ Department of Transportation (DOT) training if waste materials are to be moved off-site, and/or
- ✓ Underground storage tank training/certification, and/or
- ✓ Licensed Remediation Specialist certification, and /or
- ✓ Risk assessment training, and/or
- ✓ Ground water modeling and soil leaching modeling, and/or
- ✓ Training for various remedial systems, and/or
- ✓ Training for non-routine field sampling techniques or field screening methods, and/or
- ✓ Training and certification for monitoring well drillers.

On-site contractors are responsible for providing any specialized training and/or certification for their personnel. Furthermore, they are responsible for assuring that all required training and/or certification requirements are met and are documented.

In accordance with Section 4.0 of the WVDEP Quality Management Plan, WVDEP managers are responsible for ensuring that each staff member involved with collecting environmental data has the necessary technical, quality assurance, and project management training and certifications or documentation required for their assigned tasks and functions. Managers are also responsible for ensuring that technical staff maintains the necessary level of proficiency to effectively meet QA responsibilities. QA training and additional development needs will be identified as part of regular performance discussions.

Maintaining staff proficiency is the joint responsibility of the individuals filling those positions and the managers. Program and/or Project Managers shall have a working knowledge, through appropriate training, of the WV DEP planning process (i.e., DQO process) and the EPA QAPP

requirements. The Division Directors oversee Assistant Directors and/or Program Managers who are responsible for arranging, providing and documenting the proper training of personnel.

2.5.2 Analytical Laboratory Personnel

All analytical work for OER programs must be performed by a WVDEP certified laboratory. Laboratory certification is conducted in accordance with the requirements of the West Virginia Legislative Rules, Title 47 Series 32 *Regulations Governing Environmental Laboratories Certification and Standards Performance*. A copy of Title 47 Series 32 is located in Appendix B of this plan. Education and experience requirements for laboratory supervisors are found in Table 2 of this regulation. The Quality Assurance Program Plans of the contracted laboratories have been approved by the WVDEP. During this review/approval process, WVDEP verifies that the laboratory's personnel, facilities, sample handling procedures, equipment, instrument calibration procedures, analytical methods, standard operating procedures, and data management procedures are for the methods being used. Information on WVDEP's Laboratory Quality Assurance Program can be obtained by accessing the following internet address: <http://www.dep.wv.gov/WVE/Programs/lab/Pages/default.aspx>.

3.0 DATA GENERATION AND ACQUISITION

Prior to the on-site initiation of an investigation, the OER Project Manager will review the files and, if applicable, review the subject facility's compliance history and any relevant submissions or other historical data that might be relevant to the project. If appropriate, the OER Project Manager will confer with counterparts from other programs to determine if there are multimedia or cross-program concerns to be aware of or to be addressed during the inspection. Finally, the OER Project Manager ascertains what equipment (such as field screening equipment or sampling materials) will be necessary to accomplish his/her investigation goals.

3.1 Sampling Methods Requirements

The purpose of performing an investigation is to determine the presence and identity of contaminants along with the extent to which they have become integrated into the surrounding environment. The objective is to collect and analyze sample(s) which are representative of the media under investigation. The conceptual site model (CSM) will be used for development of the sampling program. The purpose of the model is to provide a visual representation of and to identify the following:

- ✓ Anticipated contaminants.
- ✓ Primary and secondary source areas.
- ✓ The release mechanism.
- ✓ Potential migration pathways.
- ✓ Anticipated media of concern.
- ✓ Potential exposure pathways.
- ✓ Potential receptors.

The CSM is developed based upon the historical information about former site activities, any available data about the physical and chemical characteristics of the media of potential concern, and a listing of the potential environmental receptors of concern. Based on the CSM, crucial pathways and media requiring assessment can be identified, and can later be used to evaluate whether the data makes sense for what is known about the site. The various sampling strategies that can be employed at a specific site can be grouped into two basic categories: statistical and non-statistical methods. Applications and limitations of each sampling strategy are briefly described in Table 1. Specific sampling strategies and sample locations shall be described in the Site-specific Sampling and Analysis Plans that are developed for each site. A site-specific QAPP shall be generated for each project. This document may be a separate document from the site-specific SAP or may be included as an appendix in the site-specific SAP. The site-specific QAPP should generally follow the outline of this generic QAPP while addressing the site-specific issues for the given project. The site-specific QAPP should include, but not be limited, to the following:

- ✓ Identification of project personnel including contractors and subcontractors.
- ✓ The appropriate chain of command for the project.
- ✓ Identification of the laboratory and include the lab's quality control manual, certifications, performance evaluation studies, and recent method detection limit studies.
- ✓ Any special training requirements.
- ✓ Site history including a summary of any previous data collected, soil geology, ground water information, any previous actions taken at the site.
- ✓ Applicable regulations and action limit rationale.
- ✓ Data quality control objectives and criteria for measurement data.
- ✓ Identification of critical samples.
- ✓ Sample locations and frequency (in tabular format as well as in figures).
- ✓ Sampling and analysis methods including standard operating procedures for both field and lab, holding times, preservatives, sample containers, and so forth.
- ✓ Sampling handling and custody requirements.
- ✓ Sample matrices, sample type (composite, grab, field screening, etc.) and number of samples required including providing justification for type and number of samples.
- ✓ Identification and location of background samples.
- ✓ Identification of field QC samples (field duplicates, rinsates, trip blanks, etc.).
- ✓ Identification of laboratory QC samples (MS, MSD and/or MD).
- ✓ Instrument/Equipment maintenance and calibration frequency for both field and lab equipment.
- ✓ Data management (including sample documentation, field logbook and data collection requirements, Standard Operating Procedures for both field and lab, and analytical data deliverable requirements).
- ✓ Data acquisition requirement for non-direct measurements.
- ✓ Assessment and oversight including performance and system audits for both field and lab and the frequency for oversight of field activities.
- ✓ Discussion of the methodology and level of data validation.

The methods and equipment used for sampling environmental matrices vary with the associated physical and chemical properties. Sample collection and preservation procedures will be conducted in accordance with *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (commonly known as SW-846)* and/or other Environmental Protection Agency (EPA) approved sample collection and preservation procedures for the appropriate media sampled, including soils, sediments, sludge, waste material, surface water, ground water, and, in some cases, air monitoring. Soils and sediment data should be reported on a “dry weight” basis. In order to allow data validation in accordance with EPA protocols, the analytical laboratory should generate documentation equivalent to a full Contract Laboratory Program (CLP) deliverables package for projects within the Voluntary Remediation Program and for those seeking closure under UECA. With respect to samples collected for the LUST program or samples collected for waste characterization purposes, documentation equivalent to a full CLP deliverable package is generally not warranted, unless the responsible party intends to bring the LUST site into the Voluntary Remediation Program or will seek risk based closure under UECA.

To ensure that uniform and acceptable sampling protocols for each project are being used, the sampling requirements found in Table 2 will be used for all applicable site-specific projects. It is noted that additional analytical parameters in addition to those listed in Table 2 may be required for specific projects. In this event, the site-specific SAP will list the additional analytical parameters and provide the sampling requirements for those parameters. Furthermore, these new analytical parameters will be added to the QAPP upon review and revision, as appropriate.

Prior to the initiation of data collection activity designed to evaluate environmental conditions at a site, a site-specific Sampling and Analysis Plan (SAP) will be prepared. The SAP shall:

- ✓ Logically evaluate available site information.
- ✓ Specify site-specific Measurement Quality Objectives for precision, accuracy and completeness for each parameter being measured.
- ✓ Select an appropriate sampling design.
- ✓ Select and utilize suitable geophysical, analytical screening, and sampling techniques.
- ✓ Employ proper sample collection and preservation techniques.
- ✓ Describe the collection and analysis of the appropriate QA/QC samples.
- ✓ Logically present and interpret analytical and geophysical data.
- ✓ Define data usability criteria.

The SAP shall include, but not be limited to:

- ✓ Site history including a summary of any previous data collected, soil geology, ground water information, any previous actions taken at the site.
- ✓ Applicable regulations and Action Limit rationale.
- ✓ Data quality objectives and level of data validation required.
- ✓ Identification of Project Personnel including contractors, and subcontractors and the appropriate chain of command for the project.
- ✓ Identify the laboratory and include the lab's quality control manual, certifications, performance evaluation studies, and recent method detection limit studies.

- ✓ Sample locations and frequency (in tabular format as well as in figures).
- ✓ Identification of critical samples.
- ✓ Sampling and Analysis Methods including standard operating procedures for lab and field, holding times, preservatives, sample container description, and so forth.
- ✓ Sample matrices.
- ✓ Sample Type (composite, grab, field screening, etc.) and number of samples required.
- ✓ Provide justification for type and number of samples.
- ✓ Identification and location of background samples.
- ✓ Identification of Field QC samples (field duplicates, rinsates, trip blanks, etc.).
- ✓ Identification of Laboratory QC samples (MS, MSD and/or MD).
- ✓ Decontamination procedures and disposal of investigative derived waste.
- ✓ Site-specific Safety and Health Plan as an appendix if it is not to be submitted as a separate document.

During the initiation of data collection activities, Standard Operating Procedures (SOPs) are followed pertaining to sampling methods. Sample collection SOPs and equipment decontamination procedures are provided in Appendix B with the understanding that the SOPs presented are not all inclusive of the types of media, sampling, and decontamination procedures that may be performed at any given site. As appropriate, SOPs for situations not addressed in Appendix B will be required in a site-specific SAP. Furthermore, these new SOPs will be added to the QAPP upon review and revision, as appropriate. Sometimes problems may be encountered in the field, in the laboratory, and/or unexpected results may be found at a site which necessitates additional site characterization. In such cases, an addendum must be made to the site-specific SAP and QAPP that addresses these findings and provides for procedures for additional site characterization activities.

Also, it is noted that SOPs are not provided in Appendix B for the various laboratories used by OER since OER only allows the use of WVDEP Certified Laboratories. For certification, laboratories must submit their SOPs to the Laboratory Quality Assurance Program Manager for the West Virginia Division of Water and Waste Management who is responsible for ensuring that certified laboratories meet state requirements.

3.2 Sample Handling and Custody Requirements

All field documentation should be done in indelible ink. Errors in field sampling documents will be corrected by drawing a single line through the error, writing in the correction, and initialing and dating the correction.

Sample labels are required to properly identify the samples. All samples will be labeled in the field and care will be taken to assure that each sample container is properly labeled. The samples will be placed in sealed plastic bags to prevent the labels from soaking off or becoming illegible from exposure to ice/water during transport to the laboratory. Labels will contain the following information:

- ✓ Site name and designated project number.

- ✓ Sample identification number.
- ✓ Date and time the sample was collected.
- ✓ Description of the sample.
- ✓ Sampling location.
- ✓ Notation of whether preservatives were added to the sample and type of preservative.
- ✓ Type of sample (such as a grab or composite).
- ✓ Type of analysis requested.
- ✓ Seals shall be placed on each sample container.

Chain-of-custody procedures provide documentation of the handling of each sample from the time it is collected until analysis is completed. Chain-of-custody procedures are implemented so that a record of sample collection, transfer of samples between personnel, sample shipping, and receipt by laboratory that will analyze the sample is maintained. The chain-of-custody record serves as a legal record of possession of the sample. To simplify records and eliminate potential litigation problems, as few people as possible should handle the samples during the investigation. All samples will be maintained in accordance with the following chain of custody procedures. A sample is considered to be under custody if one or more of the following criteria are met:

- ✓ In a person's physical possession.
- ✓ In view of that person after he/she has taken possession.
- ✓ Secured by that person so that no one can tamper with the sample.
- ✓ Secured by that person in an area which is restricted to authorized personnel.

A chain-of-custody record must always be maintained from the time of sample collection until final deposition. An example of a chain of custody form is found in **Figure 2**. Every transfer of custody will be noted and signed for with a copy of the record being kept for each individual who endorsed it. At a minimum, the chain-of-custody record includes the following information:

- ✓ Project number and site location.
- ✓ Sample identification number.
- ✓ Name of Project Manager.
- ✓ Description of the sample.
- ✓ Time and date sample was taken.
- ✓ Notation of whether preservatives were added to the sample and type of preservative added.
- ✓ Type of sample such as a grab or composite.
- ✓ Matrix of sample (i.e. water, soil, sludge, and so forth).
- ✓ Amount of sample being transported to the laboratory.
- ✓ The appropriate analytical parameters to be tested.
- ✓ Any other information, such as field screening data, that the sampler feels is pertinent to the analysis of the sample(s).
- ✓ Names and signatures of samplers.
- ✓ Signatures of all individuals who have had custody of the samples.

Custody seals will be placed on all samples. Refer to Figure 3 for an example of custody seals and sample container labels. When preparing sample containers for shipment they will be securely sealed. The custody seals will be used to demonstrate that a sample container has not been opened or tampered with. The individual who has sample custody shall always sign, date, and affix the custody seal to the sample container in such a manner that it cannot be opened unless it is broken. When samples are not under direct control of the individual responsible for them, they will be stored in a container, which will be affixed with a custody seal.

Samples will then be placed in an appropriate transport container and packed with an appropriate absorbent material such as vermiculite. All sample containers will be packed to maintain a temperature of $\leq 6^{\circ}\text{C}$, but without freezing the sample. A temperature blank will be added to each transport container that contains samples for volatile organic compound (VOC) analysis. All sample documentation will be placed in a plastic bag and affixed to the underside of each transport container lid. The transport container lid will then be closed and affixed with a custody seal accordingly. Samplers will transport environmental samples directly to the laboratory within 24 hours of sample collection, or utilize an overnight delivery service within 24 hours of sample collection.

All of the appropriate Department of Transportation (DOT) regulations for packaging, marking/labeling, and shipping hazardous materials and wastes will be followed. Air carriers that transport hazardous materials will comply with the current edition of the International Air Transport Association (IATA) Dangerous Goods Regulations. The IATA regulations detail the procedures to be used to enable the proper shipment and transportation of hazardous materials by a common air carrier. Following the current IATA regulations should ensure compliance with State and Federal Department of Transportation regulations.

3.3 Analytical Methods Requirements

Analytical methods will be selected that will achieve project objectives. Each site-specific SAP will identify analytical method numbers, extraction and/or digestion method numbers, method detection limits, and quantitation limits for each parameter. The SOPs for analytical methods will be included as an appendix in the site-specific SAP.

Where appropriate, the use of field screening or field analytical methods may be used as part of site characterization efforts. SOPs for these methods, if used, will be included as an appendix in the site-specific SAP. The SOPs should include a discussion of the field screening or field analytical methods that identifies the type(s) of instrumentation proposed for use, the relevant analytical procedure, the capability of the procedure to identify a compound or class of compounds, and the associated measures (i.e. instrument checks, calibrations, and so forth) designed to ensure that the field generated data meets the requirements for its intended use. The SOPs should also specify the percentage of the field screening samples, if appropriate for the data needs, which will be sent to a fixed laboratory for subsequent laboratory analyses and validation. Furthermore, the SOPs should outline the approach to be used for comparing the field screening results, where appropriate, to the fixed laboratory data in order to establish the reliability of the field screening data. To the extent practical, the majority of samples sent to the

fixed laboratory should correspond to field screening results at or near “action levels,” with the remainder of the samples divided equally between “high” results and “non-detects.”

3.4 Quality Control Requirements

3.4.1 Field Activities

Field QC is as vital to a project as is quality control within the laboratory. Proper execution of each project task is needed in order to yield consistent reliable information that is representative of the media and conditions being measured. The overall quality assurance objective is to ensure that data of known quality is generated so that it will be useful in meeting the intended project objectives. The OER Project Manager will be responsible for seeing that field personnel adhere to the QAPP and site-specific SAP. As needed, the OER Project Manager will confer with the QAM and/or Risk Assessor, where appropriate on issues that may affect quality control and the attainment of data quality objectives. The general field quality control requirements (for QC sample type, frequency, acceptance criteria, and corrective action) found in Table 3 shall serve as a guideline for all OER projects. It is noted that the field quality control requirements provided in Table 3 are for guidance purposes only and that field quality control requirements for a specific project will be dependent upon the data quality objectives of that project and may differ from those criteria listed in this table. In cases where the field quality control requirements are different than that listed in Table 3, the appropriate requirements will be specified in the site-specific SAP.

Furthermore, it is noted that for certain categories of samples, the collection of field quality control samples (i.e. duplicates, splits, matrix spikes, etc.) may not be the best method of ensuring attainment of DQOs. The decision to omit some types of field quality control samples for a given project must be made by the OER Project Manager in consultation with the QAM. Omission of these samples should be based on meeting project objectives and goals, rather than simply to reduce cost. The sample categories that may not be good candidates for some field quality control sample collection are described below with the understanding that the decision not to collect certain QC samples (such as splits, duplicates, matrix spikes, etc.) must clearly be discussed in the SAP. The decision not to collect certain QC samples should be approved by the OER Project Manager in consultation with the QAM and/or Risk Assessor. The sampling protocol proposed must ensure attainment of the DQOs. It should be noted that while the collection of some types of field QC samples may not be suitable for these categories, almost assuredly some form of field QC sampling such as trip blanks, equipment rinsate blanks, temperature blank and so forth are still applicable to these categories. Furthermore, several laboratory QC procedures would also apply to these categories of samples.

- | | | |
|---|----------------------|--|
| ✓ | Treatability Studies | Samples collected as part of a treatability study to demonstrate the efficacy of a remedial process may not typically employ split or duplicate samples. |
| ✓ | Process Monitoring | Samples collected to demonstrate the day-to-day effectiveness of intermediate steps during a treatment |

process may not typically employ split or duplicate samples.

- ✓ Wipe Samples Wipe samples (for polychlorinated biphenyls or lead) would not typically employ duplicate or split samples.
- ✓ Screening Data Samples collected as part of a screening program would not typically employ duplicate or split samples.

3.4.2 Laboratory Activities

A West Virginia Certified Laboratory shall be used to perform all analytical work for projects regulated by and/or directed by OER. The contract laboratory will be responsible for ensuring that their personnel adhere to their laboratory's SOPs and Quality Assurance Plan (QAP). The number and types of internal QC checks for each analytical method must be defined in the laboratory's QAP. The site-specific SAP will reference the required minimum quality control requirements for the laboratory that will be incorporated into the QAPP as a table of Analytical Quality Control Requirements taken from the Laboratory Qualifications Package and based upon the Laboratory Certification and Standards of Performance Rules. The laboratory must follow the quality objectives for precision, accuracy, representativeness, comparability, completeness, and method detection limits as set forth in their laboratory QAP. Laboratory internal QC results should include information about agreement between replicate analyses, spike and surrogate recoveries. Analysis of laboratory control samples, method blanks, matrix spikes and duplicates must be included with each analytical batch in accordance with SW-846 requirements and soils and sediment data should be reported on a "dry weight" basis. In addition, the requirements outlined in Table 3 of the Quality of Purified Water Used in Microbiology Tests found in the Laboratory Certification and Standards of Performance Rules must be followed when microbiological tests are performed.

The UECA and Voluntary Remediation Program data deliverable format is typically a Contract Laboratory Program (CLP) – like data deliverable package. With respect to samples collected for the LUST program and for waste characterization purposes, documentation would be similar to that collected for the Voluntary Remediation Program, but less detailed than the full CLP-like package. Refer to Section 3.7.5 for a description of the items typically included in a data deliverable package for the LUST program and for waste characterization purposes.

3.5 Instrument/Equipment Maintenance Requirements

3.5.1 Field Equipment

All field equipment will be maintained in accordance with each respective instrument manufacturer's operating instructions. All maintenance activities will be recorded in a logbook. For field equipment, the preventive maintenance information found in Table 4 will be used. Spare parts for the specific field equipment may be available as noted in the equipment manufacturer's operating instruction booklet, from the manufacturer as noted in Table 4. It is

noted that the field equipment listed in Table 4 are specific to the common field equipment that OER Project Managers currently have available to them. It is possible that other field equipment may be utilized on-site (equipment may be rented or contractors may have different equipment). If this is the case, field equipment maintenance requirements will be required to be addressed in the site-specific SAP.

3.5.2 Laboratory Equipment

The contract laboratory will be responsible for ensuring that their personnel adhere to the instrument/equipment maintenance requirements outlined in their Quality Assurance Plan. The instrument/equipment maintenance requirements shall conform to the manufacturer's specifications for each instrument and shall comply with all requirements of SW-846 and the State of West Virginia's Laboratory Certification program.

3.6 Instrument Calibration and Frequency

3.6.1 Field Equipment

Field equipment will be calibrated following the procedures found in Table 5. When the acceptance criteria are not met, the corrective actions found in Table 5 will be implemented. It is noted that the field equipment listed in Tables 4 and 5 are specific to the common field equipment that OER Project Managers and/or consultants routinely use at sites. It is possible that other field equipment may be utilized on-site (equipment may be rented or contractors may have different equipment). If this is the case, field equipment calibration and acceptance criteria/corrective action will be required to be addressed in the site-specific SAP. If OER acquires additional equipment, that equipment will be added to the table during revisions to the QAPP.

3.6.2 Laboratory Equipment

The contract laboratory will be responsible for ensuring that their personnel adhere to the instrument calibration procedures outlined in their Quality Assurance Plan. The instrument calibration procedures shall confirm to the requirements of SW-846 and the State of West Virginia's Laboratory Certification program.

3.7 Data Management

3.7.1 Sample Documentation

Field sample documents such as chain-of-custody, field logbook, and so forth will be legibly written in ink. Any corrections or revisions to sample documentation shall be made by lining through the original entry and initialing and dating any changes. To reiterate these requirements the following sub-sections are provided to outline sample documentation procedures that will be employed when conducting this investigation.

3.7.2 Field Logbook

The field logbook is a descriptive notebook detailing site activities and observations so that an accurate and factual account of field procedures may be reconstructed. All entries in the field logbook will be signed by the person making the entries. All field logbook entries will document the following specifics:

- ✓ Site name and project number.
- ✓ Contractor name and address.
- ✓ Names of personnel on site.
- ✓ Dates and times of entries.
- ✓ Descriptions of all relevant site activities, including site entry and exit times.
- ✓ Noteworthy events and discussions.
- ✓ Weather conditions.
- ✓ Site observations.
- ✓ Identification and description of samples and locations.
- ✓ Contractor information and names of on-site personnel.
- ✓ Dates and times of sample collections and chain of custody information.
- ✓ Records of photographs and site sketches.
- ✓ All relevant and appropriate information delineated in field data sheets and sample labels.
- ✓ Refer to Figure 3 for examples of completed “sample container and tags.”

3.7.3 Standard Operating Procedures (SOPs)

Standard operating procedures are often developed for many laboratory and field activities. When applicable and available, SOPs will be utilized in project data collection. To ensure environmental sample collection efforts are comparable, procedures found in sampling SOPs will be followed. Various SOPs for sample collection are located in Appendix B. In the event that the SOPs in Appendix B do not address a sample collection method necessary for a site, then a SOP shall be submitted in the site-specific SAP that addresses the sample collection procedures not previously addressed. The site-specific SAP will include SOPs for all field-screening methods and for non-EPA approved methods. As appropriate, these new SOPs will be added to the QAPP upon review and revision. Laboratory SOPs are submitted to the WVDEP Laboratory Quality Assurance Program Manager and approved in accordance with lab certification procedures.

3.7.4 Field Data Records

All real-time measurements and observations will be recorded in project logbooks, field data records, or in similar types of record keeping books. Field data records will be organized into standard formats whenever possible, and retained in OER’s permanent files.

3.7.5 Analytical Data Deliverable Requirements

At a minimum, analytical data deliverable packages provided by the laboratory will be in an organized, legible, and tabulated manner. Data deliverable requirements for the LUST program and for waste characterization samples normally are less stringent than those required for the Voluntary Remediation Program and would generally include the following, as applicable:

- ✓ Sample documentation (location, date and time of collection and analysis, etc.).
- ✓ Chain of custody.
- ✓ Analyte(s) identification.
- ✓ Analyte(s) quantitation.
- ✓ Determination and documentation of detection limits.
- ✓ Surrogate recovery.
- ✓ Initial and continuing calibration.
- ✓ Dilution factor.
- ✓ Moisture content (data for soils and sediments must be reported on a dry weight basis).
- ✓ Matrix spike and Matrix spike duplicate recoveries.
- ✓ Signature of laboratory representative.
- ✓ Sample paperwork, both preparatory and analysis.
- ✓ QC Blanks including method blank/instrument blank, trip, field, and/or equipment rinse blanks.
- ✓ Quality Control sample results (duplicate and/or split results).
- ✓ Laboratory sample receipt documentation indicating the condition of samples upon receipt at the lab.

Data deliverable requirements for the UECA and Voluntary Remediation Program normally are more stringent than those required for the LUST Program and would generally include the requirements for the LUST program listed above in addition to the following:

- ✓ Chromatograms.
- ✓ Internal standards recovery and retention times.
- ✓ Peak integration and labels.
- ✓ Mass spectra library comparisons, including tentatively identified compounds.
- ✓ Initial calibration verification results.
- ✓ Continuing calibration verification results.
- ✓ Laboratory control matrix spike results.

For the UECA and Voluntary Remediation Program, prior to submitting samples to the laboratory a request should be made to the lab to submit a tentatively identified compound list with each analysis for SW-846 methods such as 8260B and 8270C. The UECA and Voluntary Remediation Program deliverable format would typically be a Contract Laboratory Program (CLP) deliverable package. With respect to samples collected for the LUST program or samples collected for waste characterization purposes, documentation equivalent to a full CLP deliverable package is generally not warranted, unless the responsible party intends to bring the LUST site into the Voluntary Remediation Program or pursue closure under UECA. The analytical data deliverable format for both programs is generally in the form of a hard copy report, but it may also be submitted electronically, generally as a PDF or Excel file, on a CD. Prior to the

submission of laboratory data to OER, the laboratory's Quality Assurance Officer will review the data for accuracy, precision and completeness.

3.7.6 Data Management Procedures

All data collected during the sampling activities, including field and laboratory activities, will be recorded, reduced, reviewed, and reported. OER, the contractor, subcontractor, and LRS are responsible for these functions for field sample data. Each off-site contract laboratory receiving field samples are responsible for the recording, reduction, reviewing, and reporting of the corresponding analytical results. Analytical data will be obtained from the laboratory, when appropriate, in the form of electronic data deliverables (EDDs) developed by the agency, in addition to a hard-copy analytical data package. The EDDs are part of the Environmental Quality Information System (EQuIS) software system being incorporated within the agency's Environmental Resource Information System (ERIS) and Technical Applications and Geographic Information Systems (TAGIS) data base systems. EQuIS is designed to maintain and integrate field information (such as results, lab qualifiers, analysis dates, etc.), and data assessment information (such as assessment status, qualifiers, etc.). The laboratory submitted EDDs will undergo review by the EQuIS data-checker module, and upon completion of the data-checker review will be accepted by the OER Project Manager and updated into the ERIS project database. The LRS, contractor, and/or responsible party are responsible for the field sample collection portion of the database and will forward all information to the OER Project Manager.

It is important to note that EQuIS entries require unique identifiers for a number of categories such as facility, location, and sample numbers. This is very important to the tracking of information for a facility or a specific sample location. For example, a unique facility identifier allows the agency to track multiple permits, environmental actions, water quality assessments and the like across the many divisions of DEP. In the case of sampling locations and sample numbers at a site, a unique identifier should be reported only once to describe the sampling location and the subsequent sampling event. For example, MW1 could be used to describe the sampling location designated as monitoring well #1. The sample identifier could be listed as MW1-11-8-10 indicating a sample collected on November 8, 2010 from monitoring well #1. Refer to the Draft Electronic Data Deliverable Specifications Manual for specific information on the data entry requirements for preparing and submitting data electronically. A copy of the Draft Electronic Data Deliverable Specifications Manual can be viewed and obtained by going to the following internet address: <http://www.dep.wv.gov/insidedep/Pages/equis.aspx>. It should be noted that this document is a "Draft"; therefore, some items in the document may require revision and updating. However, the document provides a very good overview of the processes and requirements involved in entering and submitting data into EQuIS.

Hard copies of information relating to a site are placed in files in the file room while actions at the sites are on-going. Once a site attains a "No Further Action" or "Certificate of Completion" action, then all hard copies of information related to the site are scanned and retained electronically in the WVDEP database, indefinitely. The hard copies are then boxed, indexed and sent for indefinite storage to the WVDEP archives. Submittals of electronic information are retained within the WVDEP database and all electronic files are backed-up daily.

3.8 Data Acquisition Requirements for Non-Direct Measurements

Non-direct measurements refer to data and other information that has been previously collected or generated under some effort outside the specific project being addressed. Non-direct measurement data may include data from inspection activities, computer models, literature files, or computer databases. Refer to Appendix D for a copy of various inspection forms and checklists used by OER.

The use of data from non-direct measurements should be evaluated to determine its appropriateness for a specific project. It is anticipated that the use of non-direct measurement data for specific projects will be addressed in a site-specific Quality Assurance Project Plan for the site. In some instances, Contractors or OER may provide the site-specific Quality Assurance Project Plan as a section within the site-specific SAP. The following issues regarding information on how non-direct measurements are acquired and used on the project will be addressed in the site-specific plans for the project:

- ✓ The need and intended use of each type of data or information to be acquired;
- ✓ How the data will be identified or acquired, and the expected sources of the data;
- ✓ The method of determining the underlying quality of the data; and
- ✓ The criteria established for determining whether the level of quality for a given set of data is acceptable for use on the project.

Furthermore, the acceptance criteria for the data should also be addressed in the site-specific plans for the project. In general, the acceptance criteria for individual data values address issues such as the following:

- | | |
|-----------------------|--|
| ✓ Representativeness: | Representativeness expresses the degree to which the data is sufficiently similar. Were the sampling and analytical methods used to generate the collected data acceptable to the project? |
| ✓ Bias | Are there characteristics to the data that may shift the conclusions? Is there sufficient information to estimate and correct bias? |
| ✓ Precision | What is the estimate of the variability of the data? |
| ✓ Qualifiers | Has the data been evaluated in a manner that will allow for logical decisions to be made about the applicability of the data for use in the project? |
| ✓ Summarization | Is the data summarization process clear and sufficiently consistent with the goals of the current project? |

4.0 ASSESSMENT AND OVERSIGHT

4.1 Performance and Systems Audits

Internal and external performance and systems audits may be undertaken to evaluate the capability and performance of the total measurement system during data collection and management activities. Audits may be utilized to ensure that field and laboratory activities will provide data reflective of the site and its conditions.

A performance audit is performed to evaluate the accuracy of the total measurement system or component thereof. A systems audit focuses on evaluating the principal components of a measurement system to determine proper selection and use. In regard to field sampling operations, this oversight activity is performed to critique the quality control procedures that are to be employed. Systems audits of this nature may be performed periodically prior to or shortly after field operations commence and until the project is completed.

4.1.1 Field Activities

Analytical procedures are often targeted as the main source of error in data analysis, but generally only represent a minimal contribution to the total error. Field errors are often the major source of error. Potential sources of field error are sample collection, sample handling, transport, preparation, preservation, and sample identification.

Quality assurance of field sampling activities requires oversight of the various tasks involved in the field operations. Field oversight assures that approved methods and procedures are utilized in performing the work. Data generated for all projects must be of known quality and should also be technically and legally defensible. The necessity for and frequency of field sampling oversight shall be addressed in the site-specific SAP once the scope and objectives of the proposed task are documented. Prior to the initiation of any field sampling activities, the OER Project Manager must approve all sampling and analytical protocols for technical adequacy to ensure field personnel will collect samples properly during the field sampling activities. Oversight applies to both contract and in-house executed field sampling activities for any project phase. As needed, the OER Project Manager and Risk Assessor will consult with the QAM concerning the technical adequacy of Sampling and Analysis Plans.

Field audit checklists are useful tools in conducting and documenting that approved protocols are being followed. In general, the OER Project Manager is responsible for performing field audits; however, the Project Manager may request that the QAM perform a field audit. Checklists that may be used by the OER Project Manager and/or QAM for various field sampling activities are presented in Appendix D. The approved site-specific SAP, along with the field audit checklists, may be used as the basis for conducting field sampling oversight. As necessary, field audit checklists will be developed to address field sampling activities not described in Appendix D.

The OER Project Manager or QAM will observe and monitor field sample collection activities and records including, but not limited to the following: sample handling, preservation, packaging, shipping, and custody procedures and records; and field equipment operation, maintenance, and field calibration procedures and records. The frequency and duration of

oversight visits should be determined by the OER Project Manager. The number of site visits and level of scrutiny will depend on the nature, length and complexity of the project, as well as past performance of the field sampling personnel and the intended use of the data. Oversight of field sampling activities should be carried out on both an announced and unannounced basis. Oversight during the first stages of a field event and during sampling of critical locations or sample media should be a priority. Field audits will evaluate compliance with the requirements of the QAPP and the project SAP employed by site personnel, to verify that:

- ✓ Field activities are in conformance with documents governing project operations;
- ✓ Actual practice agrees with written instructions;
- ✓ Appropriate field logbooks have been established; and
- ✓ Deficiencies have been addressed and appropriate corrective actions have been initiated.

4.1.2 Laboratory Activities

All contracted laboratories must participate in a performance evaluation audit program covering all analyses being performed by that laboratory. This audit must be performed in accordance with Section 3.10 of West Virginia Legislative Rules, Title 47 Series 32 *Regulations Governing Environmental Laboratories Certification and Standards Performance*. The Laboratory Quality Assurance Program Manager for the West Virginia Division of Waste and Water Management is responsible for ensuring that certified laboratories meet state requirements and ensure that they perform audits and implement corrective actions as necessary to maintain their certifications in accordance with the Title 47 Series 32 of the West Virginia Legislative Rules. A copy of Title 47 Series 32 is located in Appendix B of this plan.

4.2 Reports to Management

The OER Project Manager in consultation with the QAM will prepare any field audit results, including situations identified, corrective actions implemented, and overall assessment of field operations. The Project Manager will submit the results of field audits to the QAM for review within 30 days of the completion of the audit. Serious deficiencies identified during field audits will be reported to the appropriate personnel by the QAM within 2 business days of their discovery, with a copy of the report also submitted to the OER Assistant Director. The QAM in consultation with the OER Project Manager will begin implementation of corrective action, as needed.

The laboratory audit results, including major and minor situations identified, laboratory response to the problems, impact on data quality, and overall assessment of the laboratory will be completed by the WVDEP, OER, Quality Assurance Program, and will be made available to OER upon request. Because analytical data submitted to WVDEP is required to be generated by a laboratory certified by the Quality Assurance Program, any data generated by a laboratory that is not certified at the time of the submitted analyses may be rejected, and any additional data will not be accepted until the laboratory is properly certified. OER may require the laboratory to submit a copy of its certification along with a copy of the data deliverable package.

If changes to the QAPP or site-specific SAP are required, the requesting party will initiate the desired change by editing the existing procedure (indicating changes by underlining) and developing a schedule for implementation. The revision will be submitted with a cover letter to the other party for review, comment, and/or approval. Revisions to existing procedures must be reviewed and approved by the WVDEP OER Project Manager before being incorporated into the SAP or QAPP. Upon acceptance or approval of the revision, the change will be added to the appropriate section of the QAPP or SAP. Changes will be incorporated and documented by marking the revised pages with the revision number and date in the upper right hand corner.

4.3 Corrective Action

The QAM in consultation with an OER Project Manager will prepare Corrective Action Reports. The following general procedures are utilized for corrective action when either immediate or long-term corrective actions are necessary as a result of non-conformance in field and laboratory activities:

- ✓ Define the problem.
- ✓ Assign the responsibility to an appropriate person to investigate the problem.
- ✓ Determine the cause of the problem and describe it.
- ✓ Determine the appropriate corrective action to eliminate or minimize the problem.
- ✓ Assign an appropriate person to accept responsibility for implementing the corrective action.
- ✓ Establish the effectiveness of the suggested corrective action and implement the correction.
- ✓ Verify that the corrective action has achieved its goal and the problem has been eliminated.

4.3.1 Field Activities

Field activities that are improper will be corrected as quickly as possible. It is the responsibility of all field personnel to report any problems that might jeopardize the integrity of the data collection and the project QA objectives. The project field manager is responsible to see that the problem is documented, that corrective action is taken immediately, and that the results of the corrective action are documented. In cases where the OER Project Manager is not the project field manager, then the OER Project Manager must be notified as soon as possible for their input into the corrective action procedures. A corrective action report should be written by the field project manager and submitted to OER for inclusion into the project files. The corrective action report should detail the nature of the problem, the proposed corrective action, who was responsible for implementing the corrective action, and who verified that it was executed properly.

4.3.2 Laboratory Activities

The laboratory personnel, usually a QAM or lab supervisor, are responsible for performing corrective actions if a problem occurs at the lab that might jeopardize the integrity of the data

and the project QA objectives. Re-analysis of samples is a common acceptable corrective action at the laboratory provided that hold times have not been exceeded and/or there is sufficient sample volume remaining for a re-analysis. The laboratory is required to report to OER the need for corrective action and the corrective actions taken. The use of defined “flags” to qualify the data and the inclusion of a case narrative with the analytical data are typical ways in which a lab reports corrective actions that are taken.

4.4 Dispute Resolution

In accordance with Section 2.3 of the WVDEP Quality Management Plan, when a dispute is realized, the QAM for the Division in which the dispute occurs will attempt to resolve the dispute through negotiation with the parties to the dispute. If a resolution cannot be obtained at this level, the QAM Team will be called upon to review the dispute and attempt to reach a mediated resolution. If a resolution cannot be obtained at this level, the dispute will be taken to the Cabinet Secretary for resolution. At all levels of dispute resolution, the Division Directors will be kept advised of the progress of the dispute resolution.

5.0 DATA VALIDATION AND USABILITY

5.1 Data Review

Data review documents possible effects on the data that results from various quality control failures both in the field and in the laboratory. The initial inspection of the data is used to screen for errors and inconsistencies. The OER Project Manager will check the chain of custody forms, sample handling procedures, analyses requested, sample description, sample identification, and cooler receipt forms. Sample holding times and preservation are checked and noted. The next phase of data quality review is an examination of the actual data. By examining data from laboratory matrix spikes and duplicates, blind duplicates, trip blanks, equipment blanks, laboratory surrogate recoveries, and field samples, the OER Project Manager can determine whether the data are of acceptable quality. The OER Project Manager will confer with the QAM when there is a question concerning data usability and the QAM will further evaluate the question of data usability. Refer to Table 6 for guidelines used in evaluating data.

5.2 Data Validation

Data validation is a systematic procedure of reviewing a body of data against a set of established criteria to provide a specified level of assurance of its validity prior to its intended use. Data validation includes assessment of the whole raw data package from the laboratory. It requires that the techniques utilized be applied to the body of the data in a systematic and uniform manner. Standard EPA protocols for validation (e.g. Contract Laboratory Protocol or SW-846) should be used. However, these protocols may be modified with the approval of the Director of OER, depending on the type of analyses performed and the data quality objectives for the project.

For data validation purposes, the analytical laboratory should be required to generate documentation equivalent to a full CLP deliverables package for the Voluntary Remediation Program. With respect to samples collected for the LUST program or samples collected for waste characterization purposes, documentation equivalent to a full CLP deliverable package is generally not warranted, unless the responsible party intends to bring the LUST site into the Voluntary Remediation or pursue closure under the UECA pathway. Refer to Sections 5.2.2 and 5.2.3 for the data validation requirements for the traditional pathway for closure under the LUST Program and for waste characterization purposes.

To expedite redevelopment of sites, preliminary decisions regarding the necessity of follow up studies or the adequacy of cleanup actions using raw (non-validated) data may be utilized at certain sites with the understanding that validated data is forthcoming. It should be noted that moving forward in the absence of validated data represents a “calculated risk” and that preliminary decisions based upon non-validated data may need to be re-visited.

5.2.1 Voluntary Remediation Program and the UECA Pathway

The Voluntary Remediation Program and the UECA utilizes risk-based remediation standards as outlined in the Voluntary Remediation and Redevelopment Act Guidance Document. Data is collected under the Voluntary Remediation program or the UECA pathway to delineate the extent of contamination from sites and to formulate remedial actions utilizing risk based standards; therefore, a high level of data validation is required for this program.

The highest degree of data validation is an independent data review (third party validation), which is achieved through the use level IM2 (for inorganics) and M3 (for organics). This level of review requires 100% review of all QC elements, including raw data. This represents full validation in accordance with EPA Region 3 Modifications to the National Functional Guidelines for Evaluating Inorganics Analysis (April 1993) and EPA Region 3 Modifications to the National Functional Guidelines for Evaluating Organic Data Review (November 1994).

EPA Region 3’s Innovative Approaches to Data Validation (June 1995) allows omission of certain QC elements by selection of less stringent requirements such as level IM1 (for inorganics) and levels M1 or M2 (organics). This level of review requires 100% review of all QC elements, except raw data. The use of the lower data validation levels (IM1 and M1 or M2), in accordance with EPA Region 3’s Innovative Approaches to Data Validation, may be utilized to reduce cost while still ensuring that data of sufficient quality is generated to support the decision making process with the understanding that supporting documentation could be obtained if it was determined that a higher level of validation (IM2 and M3) was warranted. If a risk assessment is performed using data validated to the IM1 and/or M1/M2 levels, it should be clearly noted that the validation process did not consider all of the QC elements (i.e. raw data was not reviewed). Whatever decisions are made regarding data validation for specific site, the site-specific Quality Assurance Project Plan and/or SAP should clearly indicate the data validation level to be utilized and the supporting justification for using that level of validation.

Where sample results are being used for risk-based evaluations or for assessments conducted utilizing Brownfield Target grant moneys in support of redevelopment of Brownfields sites, 100% of the analytical data should be validated, irrespective of the actual level of data validation. For this reason, even the use of a lower degree of data validation would require an analytical deliverable package from the laboratory that is equivalent to a full CLP deliverables package. The minimum acceptable level of data validation for risk based closure is validation to the M2 (organics) and IM1 (inorganics) levels in accordance with the National Functional Guidelines cited above.

5.2.2 LUST Program

The LUST Program utilizes specific numerical standards for soil and groundwater clean-up levels. Since the clean-up levels are based upon numerical standards rather than risk-based standards, the level of validation for the program is not as stringent as that set for the Voluntary Remediation Program. Data collected under the LUST Program is used to delineate the extent of contamination from LUST sites and to formulate corrective action plans, which result in the subsequent closure of the sites once specific numerical clean-up standards for soil and groundwater have been reached.

Validation for the LUST program is performed in general accordance with M1 and IM1 levels of EPA Region 3's Innovative Approaches to Data Validation (June 1995), but only for those program data deliverables listed in Section 3.7.5 of this QAPP. However, if a responsible party anticipates the likelihood of bringing a LUST site into the Voluntary Remediation Program or seeking closure under UECA, OER recommends that a full CLP-like data package be obtained and that data validation be performed in full accordance with the requirements of the Voluntary Remediation Program and UECA Pathway as described above.

5.2.3 Waste Characterization

Documentation equivalent to a full CLP deliverable package is generally not warranted for samples being collected for waste characterization purposes. Validation for waste characterization samples is performed in general accordance with M1 and IM1 levels of EPA Region 3's Innovative Approaches to Data Validation (June 1995), but only for those program data deliverables listed in Section 3.7.5 of this QAPP.

5.3 Reconciliation with User Requirements

The purpose of this element is to outline the acceptable methods for evaluating the results obtained for a given project. This includes scientific and statistical evaluations (refer to Section 5.4) of data to determine if the data is of the right type, quantity, and quality to support the intended use. It is noted that scientific and statistical evaluations of data for specific projects may differ because of differing DQOs. The QC elements in Table 6 will be utilized as a general guideline for the data items requiring review and reconciliation with the DQOs. The DQOs will typically be assessed by evaluating the PARCCS of all aspects of the data collection process.

5.3.1 Precision

Precision will be determined through the use of field duplicates, matrix spike/matrix spike duplicates and duplicate quality control samples. The Relative Percent Difference (RPD) between the two results will be calculated and used as an indication of the precision of the analyses performed.

The following formula should be used to calculate precision:

$$RPD = \frac{(C_1 - C_2) \times 100}{(C_1 + C_2) / 2}$$

Where: RPD = relative percent difference
C₁ = larger of the two observed values
C₂ = smaller of the two observed values

5.3.2 Accuracy

Accuracy will be assessed through the analysis of quality control samples. The analytical accuracy will be expressed as the percent recovery (%R) of an analyte that has been added to the environmental sample at a known concentration before analysis and is calculated according to the following equation:

$$\% R = \frac{(S-U)}{C_{sa}} \times 100$$

Where: %R = percent recovery
S = measured concentration in spiked aliquot
U = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

The following formula should be used for measurements where a standard reference material is used:

$$\% R = \frac{C_m}{C_{srm}} \times 100$$

Where: %R = percent recovery
C_m = measured concentration of standard reference material
C_{srm} = actual concentration of standard reference material

5.3.3 Representativeness

Representativeness refers to the degree to which sample data accurately and precisely describe the characteristics of a population of samples, parameter variations at a sampling point, or environmental condition. Samples that are not properly collected or preserved (e.g., contaminant loss or addition) or are analyzed beyond acceptable holding times should not be considered to provide representative data. Representativeness is a parameter that is concerned primarily with the proper design of the sampling program. An assessment of representativeness would include an evaluation of precision. The representativeness criterion is best satisfied in the laboratory by making certain that all aliquots taken from a given sample are representative of the sample as a whole.

This would include sample premixing/homogenizing prior to analysis. Samples requiring volatiles analysis should not undergo any premixing or homogenization. Therefore, noting sample characteristics in a case narrative may assist in evaluating data. Representativeness can be assessed by a review of the precision obtained from the field and laboratory duplicate samples. In this way, they provide both precision and representativeness information. Applicability of representativeness in assessing a contaminant population is improved by using a larger number of samples.

5.3.4 Completeness

Completeness is the percentage of measurements that are judged to be usable (i.e., which meet project-specific requirements) compared to the total number of measurements planned. Specified levels of overall (both field and laboratory) completeness, in addition to particular completeness goals for critical samples, should be set as part of the project DQOs in the site-specific SAP. It is important that critical samples are identified and appropriate QC maintained to ensure that valid data are obtained in order to secure the requisite type, quantity, and quality of data necessary to complete the project. The desired level of completeness is dependent on the project-specific DQOs. This information will be conveyed to the laboratory within the site-specific SAP. Planning and communication among all parties involved in the process are crucial in order to achieve high completeness percentages. However, completeness goals of 100 percent are usually unattainable. Realistic completeness goals (i.e., 80-95 percent) should be determined based upon the size and complexity of the project. Data completeness will be expressed as the percentage of valid data obtained from the measurement system. For data to be considered valid, it must meet all the acceptable criteria including accuracy and precision, as well as any other criteria required by the prescribed analytical method.

The following formula should be used to calculate completeness:

$$\% C = 100 \% \left[\frac{V}{n} \right]$$

Where: %C = percent completeness
 V = number of measurements judged valid
 n = total number of measurements necessary to achieve a specified statistical level of confidence in decision making.

5.3.5 Comparability

Comparability is a quantitative objective of the data, expressing the confidence with which one data set can be compared with another. Sample data should be comparable for similar samples and sample conditions. This goal is achieved through the use of standard techniques to collect representative samples, consistent application of analytical method protocols, and reporting analytical results with appropriate units. Comparability is unknown unless precision and bias are provided. When this information is available, the data sets can be compared with confidence. When new or modified standard reference methods or field analytical techniques are employed, comparability becomes a critical and potentially quantitative data quality indicator. If comparability with standard methods has not been demonstrated, a project-specified percentage of duplicate (split) samples for analysis by the standard reference method should be included. This allows an assessment of comparability between data sets by calculating the RPD, thus determining the usability of the performance-based method in supporting project decision making.

The following formula can be used to calculate the comparability between data sets:

$$RPD = \frac{(C_1 - C_2) \times 100}{(C_1 + C_2) / 2}$$

Where: RPD = relative percent difference
C₁ = larger of the two observed values
C₂ = smaller of the two observed values

5.3.6 Sensitivity

Sensitivity is defined by the method detection limits (MDLs). The achievement of MDLs depends upon the instrument sensitivity to ensure data quality through on-going checks on instrument performance. The MDL is defined as the minimum concentration that can be measured with 99 percent confidence that the concentration is above zero.

The MDL is calculated as follows:

$$MDL = s * t_{(n-1, 1-\alpha=0.99)}$$

Where: s = standard deviation of replicate analysis
t_(n-1, 1-α=0.99) = student's t-value for a one-sided 99% confidence level and a standard deviation estimate with n-1 degrees of freedom

5.4 Statistical Measurements

Various statistical approaches or possibly models may be utilized in data review depending upon the DQOs established for a specific site and will be described in site-specific project plans. At a

minimum, data review will commonly include the statistical measurements of central tendency and dispersion. The measurements of central tendency are more meaningful when accompanied by information on how the data is dispersed out from the center.

5.4.1 Measurement of Central Tendency

Measures of central tendency characterize the center of a sample of data points. The three most common estimates of central tendency are mean, median, and mode. The most commonly used measure of the center of a sample is the mean. The mean is an arithmetic average for simple sampling designs. For complex sampling designs, such as stratification, the sample mean is a weighted arithmetic average. The sample mean is influenced by extreme values and non-detects. The sample mean is the sum of all the data points divided by the total number of data points.

The sample median is the second most commonly used measure of the center of the data. This value falls directly in the middle of the data when the measurements are ranked in order from the smallest to largest. The median is another name for the 50th percentile. The median is not influenced by extreme values and can easily be used in the case of non-detects. The sample median is the center of the data when the measurements are ranked in order from smallest to largest.

The third method of measuring the center of the data is the mode. The mode is the value of the sample that occurs with the greatest frequency. Since this value may not always exist, or if it does it may not be unique, this method is the least commonly used measure of central tendency. To find the mode, count the number of times each value occurs. The sample mode is the value that occurs most frequently.

5.4.2 Measurement of Dispersion

Measures of dispersion in a data set include calculation for the range, variance, sample standard deviation, and coefficient of variation. The easiest measure of dispersion to compute is the sample range. For small data sets, the range is easy to interpret and may adequately represent the dispersion of the data. For larger data sets, the range may not be as informative about the data since it only considers the extreme values. The sample range is the difference between the largest value and the smallest value of a data set.

The variance measures the dispersion from the mean of a data set. A small sample variance implies that there is little spread among the data so that most of the data are near the mean. A large sample variance implies that there is a large spread among the data so that most of the data are not clustered around the mean. The sample variance is affected by extreme values and by a large number of non-detects.

The sample variance can be computed by the following equation:

$$S^2 = \frac{\sum_{i=1}^n X_i^2 - 1/n \left\{ \sum_{i=1}^n X_i \right\}^2}{n-1}$$

Where: S^2 = sample variance
 X_i = data points
n = total number of data points

Sample standard deviation is the square root of the sample variance. It has the same unit of measure as the data. The sample standard deviation is the square root of the sample variance.

The coefficient of variation is a measure that allows the comparison of dispersion across several sets of data. The coefficient of variation is often used in environmental applications because variability expressed as a standard deviation is often proportional to the mean. The coefficient of variation is the standard deviation divided by the sample mean. The coefficient of variation is often expressed as a percentage.

6.0 REFERENCES

The following reference materials were used in compiling the information contained in this QAPP.

Quality Management Plan, West Virginia Department of Environment, August 2010

Corrective Action Plan Guidance Document (CAGD), West Virginia Department of Environmental Protection, Division of Land Restoration, Office of Environmental Remediation, August 2001

West Virginia Voluntary Remediation and Redevelopment Act Guidance Document, West Virginia Department of Environmental Protection, Division of Land Restoration, Office of Environmental Remediation, Version 2.1, March 2001

User Guide for Risk Assessment of Petroleum Releases, West Virginia Department of Environmental Protection, Division of Land Restoration, Office of Environmental Remediation, Version 1.0, November 1999

EPA Quality Manual for Environmental Programs, 5360 A1, United States Environmental Protection Agency, May 2000

Guidance for Developing Quality Systems for Environmental Programs, EPA QA/G-1, EPA/240/R-02/008, United States Environmental Protection Agency, November 2002

Guidance for the Data Quality Objectives Process, EPA QA/G-4, United States Environmental Protection Agency, February 2006

Guidance for Quality Assurance Project Plans, EPA QA/G-5, United States Environmental Protection Agency, December 2002

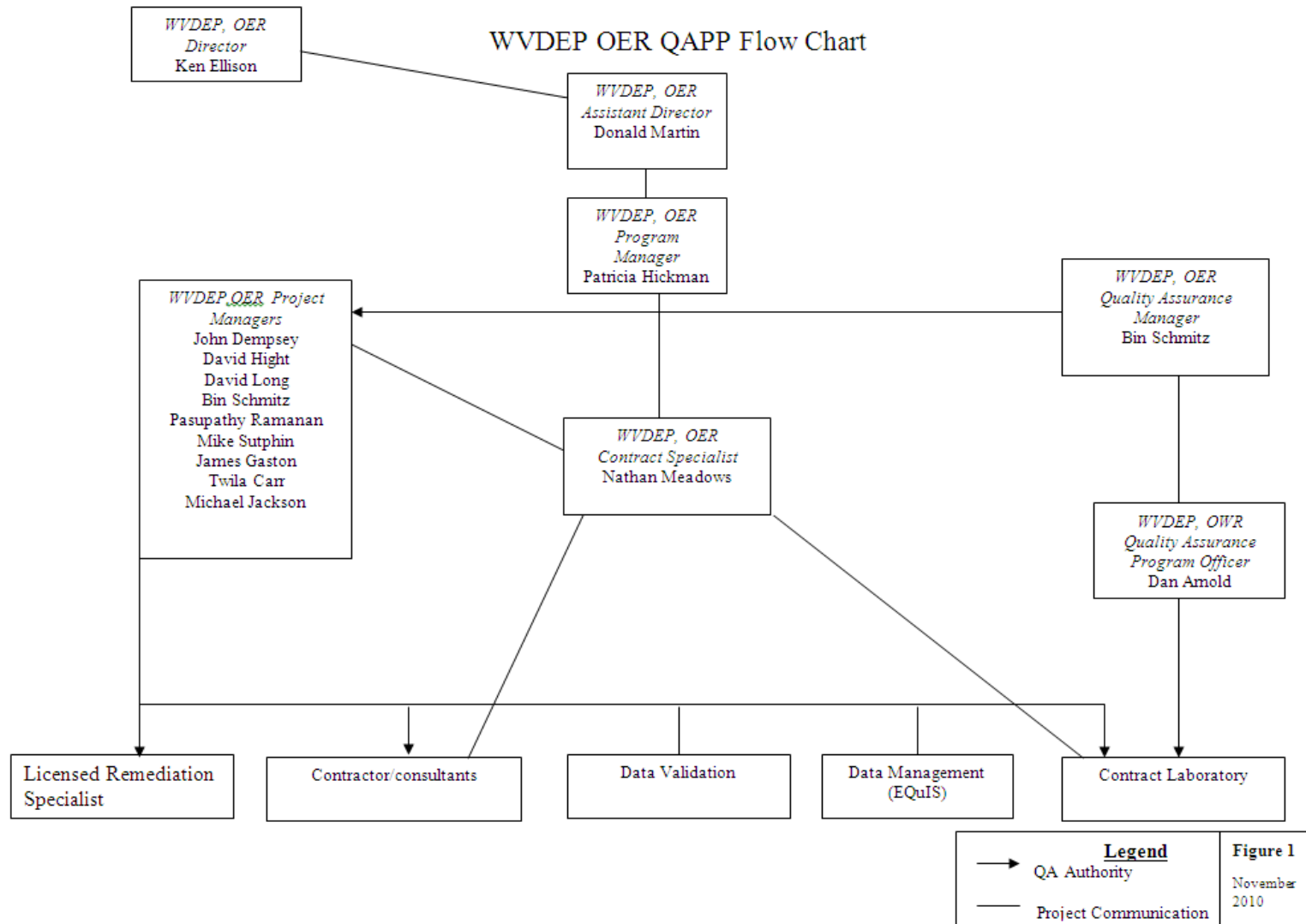
Guidance for the Preparation of Standard Operating Procedures (SOPs), EPA QA/G-6, United States Environmental Protection Agency, March 2001

Guidance on Environmental Data Verification and Data Validation, EPA QA/G-8, United States Environmental Protection Agency, November 2002

Guidance for Data Quality Assessment, EPA QA/G-9, United States Environmental Protection Agency, January 1998

Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, United States Environmental Protection Agency, November 2001

FIGURES





WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF ENVIRONMENTAL REMEDIATION

White - Retained by Lab (Project file)

Yellow - Returned with Report

Pink - Retained by Sampler

[illegible]

Figure 2
May 2006

Example Custody Seal

CUSTODY SEAL		QEC
DATE <i>04/01/06</i>		Quality Environmental Containers 800-255-3950 • 304-255-3900
SIGNATURE <i>Ruth Porter</i>		

Example Labels for Sample Containers

P.O. Box 1160 Beaver, WV 25813 800-255-3950 • 304-255-3900 Quality Environmental Containers		
PROJECT NAME <i>Hutchinson Prop. Leak ID 04-002</i>		
SAMPLE ID <i>04-002-001</i>	SAMPLE DATE <i>6/1/06</i>	SAMPLE TIME <i>8:48</i>
SAMPLED BY <i>RP</i>	PRESERVATIVE <i>Cool to 4°C</i>	
ANALYSIS REQUESTED <i>Total Lead 6010 B</i>		<input checked="" type="checkbox"/> GRAB <input checked="" type="checkbox"/> COMPOSITE <i>Soil Sample</i>

P.O. Box 1160 Beaver, WV 25813 800-255-3950 • 304-255-3900 Quality Environmental Containers		
PROJECT NAME <i>Hutchinson Prop. Leak ID 04-002</i>		
SAMPLE ID <i>04-002-MW1</i>	SAMPLE DATE <i>6/1/06</i>	SAMPLE TIME <i>10:17</i>
SAMPLED BY <i>RP</i>	PRESERVATIVE <i>HCL pH < 2 Cool to 4°C</i>	
ANALYSIS REQUESTED <i>BTX 8021 B</i>		<input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE <i>water sample</i>

Figure 3
May 2006

TABLES

Table 1
Sampling Strategies

Sampling Strategy	Description	Application	Limitation
<i>Statistical Sampling Approaches</i>			
Simple random sampling	Representative sampling locations are chosen using the theory of random chance probabilities.	Sites where background information is not available and no visible signs of contamination are present.	May not be cost-effective for samples located too close together. Does not take into account spatial variability of media.
Stratified random sampling	Site is divided into several sampling areas based on background or other site information; each area is evaluated using a separate random sampling strategy.	Large sites characterized by a number of soil types, topographic features, past/present uses, or manufacturing/storage areas.	Often more cost-effective than simple random sampling. It is more difficult to implement in the field and analyze results. Does not take into account spatial variability of media.
Systematic grid sampling	This probably the most common statistical strategy; it involves collecting samples at predetermined, regular intervals within a grid pattern.	Best strategy for minimizing bias and providing complete site coverage. Can be used effectively at sites where no background information exists. Ensures that samples will not be taken too close together.	Does not take into account spatial variability of media.
Hot-spot sampling	Systematic grid sampling strategy is tailored to search for hot spots.	Sites where background information or site investigation data indicates that hot spots may exist.	Does not take into account spatial variability of media. Chance of missing a hot-spot can be high depending upon the amount of site information available.
Geostatistical approach	Representative sampling locations are chosen based on spatial variability of media.	More appropriate than other statistical sampling strategies because it takes into account spatial variability of media. Especially applicable to sites where presence of contamination is unknown.	Previous investigation data must be available and such data must be shown to have a spatial relationship.
<i>Non-statistical Sampling Approaches</i>			
Biased sampling	Sampling locations are chosen based on available information about site history or past investigations.	Sites with specific known contamination sources.	Contaminated areas can be overlooked if they are not indicated by background information or visual signs of contamination.
Judgmental sampling	An individual subjectively selects sampling locations that appear to be representative of average conditions.	Homogeneous, well-defined sites.	Not usually recommended due to bias imposed by individual, especially for final investigations.

Table 2
Sample Containers, Preservation, Holding Times
(Page 1 of 5)

Matrix	Analytical Method	Parameter/Fraction	Minimum Sample Volume ¹	Sample Container ²	Sample Preservation ⁶	Holding Time
Soil	8021B	LUST Program³ Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) <i>Terra Core Samplers</i> < 200 ug/kg	3- 40 ml vials	Glass vials with Teflon lined cap	1 g NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01g.	14 days
		>200 ug/kg	3- 40 ml vials	Glass vials with Teflon lined cap	5mL of methanol weight checked to the nearest 0.01g.	14 days
		<i>EnCore samplers</i>	3- EnCore samplers	EnCore samplers	Cool to ≤6°C	48 hours
	8021B	Methyl t-butyl ether (MTBE), and t-butyl alcohol (TBA)⁴ <i>Terra Core Samplers</i>	3- 40 ml vials	Glass vials with Teflon lined cap	Cool to ≤6°C, add HCL to pH<2	14 days
		<i>EnCore samplers</i>	3- EnCore samplers	EnCore samplers	Cool to ≤6°C	48 hours
	8015B	Gasoline Range Organics (GRO) <i>Terra Core Samplers</i> < 200 ug/kg	3- 40 ml vials	Glass vials with Teflon lined cap	1 g NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01g.	14 days
		>200 ug/kg	3- 40 ml vials	Glass vials with Teflon lined cap	5mL of methanol weight checked to the nearest 0.01g.	14 days
		or <i>EnCore samplers</i>	3- EnCore samplers	EnCore samplers	Cool to ≤6°C	48 hours
	8015 B	Diesel Range Organics (DRO)/Oil Range Organics (ORO)	4 oz.	4 oz. wide-mouth glass with Teflon lined cap	Cool to ≤6° C	14 days

¹ Triple volume is required for matrix spike/matrix spike duplicate (MS/MSD) analysis.

² All sample bottles must comply with the standards outlined in the following reference: U.S. EPA (Environmental Protection Agency). December 1992. *Specifications and Guidance for Contaminant-Free Sample Containers*. OSWER Directive #9240.0-05A, EPA 540/R-93/051. Office of Solid Waste and Emergency Response, Washington, DC.

³ SW- 846 sampling method 5035 may be used for VOCs associated with leaking underground storage tank sites. The sample methodology may also be applicable to Non- LUST sites. Also, Method 8260 B may be utilized for BTEX and MTBE analysis as an alternative to Method 8021B.

⁴ If analysis by 8021B indicates the presence of MTBE or TBA, confirmation analysis by 8260B is required in the LUST program.

⁵ Methods listed for the LUST program for aqueous samples may also be applicable to Non-LUST sites.

⁶ Cool sample to ≤ 6°C, but without freezing the sample.

Table 2
Sample Containers, Preservation, Holding Times
(Page 2 of 5)

Matrix	Analytical Method	Parameter/Fraction	Minimum Sample Volume ¹	Sample Container ²	Sample Preservation ⁶	Holding Time
Soil	8270C	Polynuclear Aromatic Hydrocarbons (PAHs)	4 oz.	4 oz. wide-mouth glass with Teflon lined cap	Cool to ≤6°C	14 days
	1311/7420	Lead (Toxicity Characteristic Leaching Procedure-TCLP)	4 oz.	4 oz. wide-mouth glass with Teflon lined cap	Cool to ≤6°C	180 days
Aqueous	8021B	<u>LUST Program</u>⁵ Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)	3- 40 ml vials	Glass vials with Teflon lined cap	Cool to ≤6°C, HCL to pH <2	7 days
	8021B	Methyl t-butyl ether (MTBE), and t-butyl alcohol (TBA)⁴	3- 40 ml vials	Glass vials with Teflon lined cap	Cool to ≤6°C, add HCL to pH<2	7 days
	8015B	Gasoline Range Organics (GRO)	3- 40 ml vials	Glass vials with Teflon lined cap	Cool to ≤6°C, add HCL to pH<2	7 days
	8015B	Diesel Range Organics (DRO)/Oil Range Organics (ORO)	2- 1250 ml	1250 ml amber glass with Teflon lined cap	Cool to ≤6°C	7 days
	8270C	Polynuclear Aromatic Hydrocarbons (PAHs)	2- 1250 ml	1250 ml amber glass with Teflon lined cap	Cool to ≤6°C	7 days

¹ Triple volume is required for matrix spike/matrix spike duplicate (MS/MSD) analysis.

² All sample bottles must comply with the standards outlined in the following reference: U.S. EPA (Environmental Protection Agency). December 1992. *Specifications and Guidance for Contaminant-Free Sample Containers*. OSWER Directive #9240.0-05A, EPA 540/R-93/051. Office of Solid Waste and Emergency Response, Washington, DC.

³ SW- 846 sampling method 5035 may be used for VOCS associated with leaking underground storage tank sites. The sample methodology may also be applicable to Non- LUST sites. Also, Method 8260 B may be utilized for BTEX and MTBE analysis as an alternative to Method 8021B.

⁴ If analysis by 8021B indicates the presence of MTBE or TBA, confirmation analysis by 8260B is required in the LUST program.

⁵ Methods listed for the LUST program for aqueous samples may also be applicable to Non-LUST sites.

⁶ Cool sample to ≤6°C, but without freezing the sample.

Table 2
Sample Containers, Preservation, Holding Times
(Page 3 of 5)

Matrix	Analytical Method	Parameter/Fraction	Minimum Sample Volume ¹	Sample Container ²	Sample Preservation ⁶	Technical Holding Time
Soil/ Sediment	8260B	Volatile Organic Compounds	4 oz.	4 oz. clear wide-mouth glass with Teflon lined septum.	Cool to ≤6°C	14 days
		<u>VOCS (Extraction Method 5035)</u>				
		Terra Core Samplers < 200 ug/kg	3- 40 ml vials	Glass vials with Teflon lined cap	1 g NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01g.	14 days
		>200 ug/kg	3- 40 ml vials	Glass vials with Teflon lined cap	5mL of methanol weight checked to the nearest 0.01g.	14 days
	8270C 8081A 8082 8270C/ 8310 6010B/ 7471A	or EnCore samplers	3- EnCore samplers	EnCore samplers		48 hours
		Semi-volatile Organic Compounds (SVOCs)	4 oz.	4 oz. wide-mouth glass with Teflon lined cap.	Cool to ≤6°C	14 days
		Pesticides	4 oz.	4 oz. wide-mouth glass with Teflon lined cap.	Cool to ≤6°C	14 days
		Polychlorinated Biphenyls (PCBs)	4 oz.	4 oz. wide-mouth glass with Teflon lined cap.	Cool to ≤6°C	14 days
		Polynuclear Aromatic Hydrocarbons (PAHs)	4 oz.	4 oz. wide-mouth amber glass with Teflon lined cap.	Cool to ≤6°C	14 days
		Total Metals	4 oz.	4 oz. clear wide-mouth glass with Teflon lined cap.	Cool to ≤6°C	180 days (28 days Hg)

¹ Triple volume is required for matrix spike/matrix spike duplicate (MS/MSD) analysis.

² All sample bottles must comply with the standards outlined in the following reference: U.S. EPA (Environmental Protection Agency). December 1992. *Specifications and Guidance for Contaminant-Free Sample Containers*. OSWER Directive #9240.0-05A, EPA 540/R-93/051. Office of Solid Waste and Emergency Response, Washington, DC.

³ SW- 846 sampling method 5035 may be used for VOCS associated with leaking underground storage tank sites. The sample methodology may also be applicable to Non- LUST sites. Also, Method 8260 B may be utilized for BTEX and MTBE analysis as an alternative to Method 8021B.

⁴ If analysis by 8021B indicates the presence of MTBE or TBA, confirmation analysis by 8260B is required in the LUST program.

⁵ Methods listed for the LUST program for aqueous samples may also be applicable to Non-LUST sites.

⁶ Cool sample to ≤6°C, but without freezing the sample.

Table 2
Sample Containers, Preservation, Holding Times
(Page 4 of 5)

Matrix	Analytical Method	Parameter/Fraction	Minimum Sample Volume ¹	Sample Container ²	Sample Preservation ⁶	Technical Holding Time
Soil/ Sediment	SW846/1311, 6010B, 7471A	TCLP metals	9 oz.	9 oz. wide-mouth glass with Teflon lined cap	Cool to ≤6°C	180 days (28 days Hg)
	SW846/1311, 8260B	TCLP volatiles	9 oz.	9 oz. wide-mouth glass with Teflon lined cap	Cool to ≤6°C, no headspace	14 days until extraction, analyze within 40 days of extraction
	SW846/1311, 8270C	TCLP semi-volatiles	9 oz.	9 oz. wide-mouth glass with Teflon lined cap	Cool to ≤6°C	7 days until extraction, analyze within 40 days of extraction
	SW846/1311, 8081, 8151	TCLP herbicides and pesticides	9 oz.	9 oz. wide-mouth glass with Teflon lined cap	Cool to ≤6°C	7 days until extraction, analyze within 40 days of extraction
	Aqueous	Volatile Organic Compounds	2- 40 ml	40 ml VOC vial with Teflon lined septum.	Cool to ≤6°C ³ 1:1 HCl to pH<2	14 days
		Semi-volatile Organic Compounds	1 Liter	1 Liter amber glass with Teflon lined cap.	Cool to ≤6°C	7 days
		Polynuclear Aromatic Hydrocarbons (PAHs)	1 Liter	1 Liter amber glass with Teflon lined cap.	Cool to ≤6°C	7 days

¹ Triple volume is required for matrix spike/matrix spike duplicate (MS/MSD) analysis.

² All sample bottles must comply with the standards outlined in the following reference: U.S. EPA (Environmental Protection Agency). December 1992. *Specifications and Guidance for Contaminant-Free Sample Containers*. OSWER Directive #9240.0-05A, EPA 540/R-93/051. Office of Solid Waste and Emergency Response, Washington, DC.

³ SW- 846 sampling method 5035 may be used for VOCs associated with leaking underground storage tank sites. The sample methodology may also be applicable to Non- LUST sites. Also, Method 8260 B may be utilized for BTEX and MTBE analysis as an alternative to Method 8021B.

⁴ If analysis by 8021B indicates the presence of MTBE or TBA, confirmation analysis by 8260B is required in the LUST program.

⁵ Methods listed for the LUST program for aqueous samples may also be applicable to Non-LUST sites.

⁶ Cool sample to ≤ 6°C, but without freezing the sample.

Table 2
Sample Containers, Preservation, Holding Times
(Page 5 of 5)

Matrix	Analytical Method	Parameter/Fraction	Minimum Sample Volume ¹	Sample Container ²	Sample Preservation ⁶	Technical Holding Time
Aqueous	8081/8082	Pesticides/PCBs	1 Liter	1 Liter amber glass with Teflon lined cap.	Cool to $\leq 6^{\circ}\text{C}$	7 days
	6010B/ 7470A	Total Metals	1 Liter	1 Liter HDPE bottle with Teflon lined cap.	1N HNO ₃ to pH<2; Cool to $\leq 6^{\circ}\text{C}$	180 days (28 days Hg)
	SW846/1311, 6010B, 7470A	TCLP metals	2 Liters	2 1-Liter HDPE bottle with Teflon lined cap.	Cool to $\leq 6^{\circ}\text{C}$	180 days (28 days Hg)
	SW846/1311, 8260B	TCLP volatiles	2- 40 ml	2-40 ml VOC vial with Teflon lined septum.	Cool to $\leq 6^{\circ}\text{C}$	14 days until extraction, analyze within 40 days of extraction
	SW846/1311, 8270C	TCLP semi-volatiles	2 Liters	2 1-Liter amber glass with Teflon lined cap.	Cool to $\leq 6^{\circ}\text{C}$	7 days until extraction, analyze within 40 days of extraction
	SW846/1311 8081, 8151	TCLP herbicides and pesticides	2 Liters	2 1-Liter amber glass with Teflon lined cap.	Cool to $\leq 6^{\circ}\text{C}$	7 days until extraction, analyze within 40 days of extraction

¹ Triple volume is required for matrix spike/matrix spike duplicate (MS/MSD) analysis.

² All sample bottles must comply with the standards outlined in the following reference: U.S. EPA (Environmental Protection Agency). December 1992. *Specifications and Guidance for Contaminant-Free Sample Containers*. OSWER Directive #9240.0-05A, EPA 540/R-93/051. Office of Solid Waste and Emergency Response, Washington, DC.

³ SW- 846 sampling method 5035 may be used for VOCs associated with leaking underground storage tank sites. The sample methodology may also be applicable to Non- LUST sites. Also, Method 8260 B may be utilized for BTEX and MTBE analysis as an alternative to Method 8021B.

⁴ If analysis by 8021B indicates the presence of MTBE or TBA, confirmation analysis by 8260B is required in the LUST program.

⁵ Methods listed for the LUST program for aqueous samples may also be applicable to Non-LUST sites.

⁶ Cool sample to $\leq 6^{\circ}\text{C}$, but without freezing the sample.

Table 3
Field Quality Control Requirements

Type of QC Sample	Frequency	Acceptance Criteria ³	Corrective Action ⁴
Field Duplicate	One per twenty samples per matrix or one per day, whichever is more frequent.	50% of Relative Percent Difference (RPD) or 2 times the method detection limit (MDL)	Corrective actions may include any of the following: reanalyzing suspect samples; resampling and reanalyzing; accepting data with an acknowledged level of uncertainty; re-calibrating analytical instruments; and/or discarding the data.
Split Sample	10% of field screening data will be confirmed with data from a fixed laboratory. ¹	50% of Relative Percent Difference (RPD) or 2 times the method detection limit (MDL)	Corrective actions may include any of the following: reanalyzing suspect samples; resampling and reanalyzing; accepting data with an acknowledged level of uncertainty; re-calibrating analytical instruments; and/or discarding the data.
Matrix Spike/ Matrix Spike Duplicate (MS/MSD) ²	One per twenty samples per matrix or one per day, whichever is more frequent.	Recovery within $\pm 50\%$ for spikes at 10 times MDL	Corrective actions may include any of the following: Review chromatograms and raw data quantitation reports; check instrument response using calibration standard; attempt to correct matrix problem and reanalyze sample; resampling and reanalyzing; accepting data with an acknowledged level of uncertainty; and/or discarding the data.
Equipment Rinsate Blank	One per twenty samples per matrix per equipment type per decontamination event or one per day, whichever is more frequent.	< minimum detection limit or < 30% of lowest sample up to 2 times the MDL	Corrective actions may include any of the following: reanalyzing suspect samples; resampling and reanalyzing; qualify data as necessary, accepting data with an acknowledged level of uncertainty; re-calibrating analytical instruments; and/or discarding the data.
Field Blank	One per twenty samples per matrix or one per day, whichever is more frequent.	< minimum detection limit or < 30% of lowest sample up to 2 times the MDL	Corrective actions may include any of the following: reanalyzing suspect samples; resampling and reanalyzing; qualify data as necessary, accepting data with an acknowledged level of uncertainty; re-calibrating analytical instruments; and/or discarding the data.
VOA Trip Blank	One for each cooler which contains samples for VOA analyses.	< minimum detection limit or < 30% of lowest sample up to 2 times the MDL	Corrective actions may include any of the following: reanalyzing suspect samples; resampling and reanalyzing; qualify data as necessary, accepting data with an acknowledged level of uncertainty; re-calibrating analytical instruments; and/or discarding the data.
Cooler Temperature Blank	One per cooler.	≤ 6 degrees Celsius	Corrective actions may include any of the following: resampling; qualify data as necessary, and/or accepting data with an acknowledged level of uncertainty.

1 The frequency cited is Per Superfund Data Quality Objectives Process for Superfund Sites and may not be applicable to all OER project sites. The collection of split samples will be dependent upon the data quality objectives for a given site.
2 Sufficient sample will be collected to allow the laboratory to perform this analysis.
3 The acceptance criteria provided are for guidance purposes only. The acceptance criteria for a specific project will be dependent upon the data quality objectives of that project and may differ from those criteria listed in this table. In cases where the acceptance criteria is different than that listed above, it will be specified in a site-specific Quality Control Plan (QCP) or Sampling and Analysis Plan (SAP).
4 The corrective actions provided are for guidance purposes only. The corrective action procedures listed may vary depending upon the data quality objectives and the acceptance criteria provided in the site-specific QCP or SAP.

Table 4
Preventive Maintenance - Field Equipment¹

Instrument	Activity	Frequency
GasTechtor 1314, TankTechtor, and Gas Tech 201, Thermo Gastech Innova	Check battery	Each usage and replace as necessary
GasTechtor 1314, TankTechtor, and Gas Tech 201, Thermo Gastech Innova	Replace filter element in inlet fitting	As necessary
GasTechtor 1314, TankTechtor, and Gas Tech 201, Thermo Gastech Innova	Replace O ₂ sensor	As necessary as indicated during calibration (~ 1/yr.)
GasTechtor 1314, TankTechtor, and Gas Tech 201, Thermo Gastech Innova	Replace Combustible detector	As necessary as indicated during calibration
MicroTIP	Check battery	Each usage and replace as necessary
MicroTIP	Clean (replace) filter element in inlet	As necessary as indicated during calibration
MicroTIP	Clean (replace) lamp	As necessary as indicated during calibration
pH & temperature meter	Check battery	Each usage and replace as necessary
pH & temperature meter	Check for damage (scratches, cracks or breaks) to the probe	Each usage and replace as necessary
pH & temperature meter	Clean probe and store wet	Probe should be rinsed with distilled water after every usage; clean with manufacturer suggested cleaning solution (usually dilute acid solution for salt deposits) as necessary
Conductivity	Clean probe	Probe should be rinsed with distilled after every usage; clean with manufacturer suggested cleaning solution (usually dilute acid) as necessary
Conductivity	Check battery	Each usage and replace as necessary
Conductivity	Check for damage to the probe	Each usage and replace as necessary
Oxidation-Reduction Potential (ORP)	Clean probe	Probe should be rinsed with distilled after every usage; clean with manufacturer suggested cleaning solution as necessary
ORP	Check battery	Each usage and replace as necessary
ORP	Check for damage to the probe	Each usage and replace as necessary
Dissolved oxygen	Check battery	Each usage and replace as necessary
Dissolved oxygen	Clean probe	Probe should be rinsed with distilled after every usage; clean with manufacturer suggested cleaning solution as necessary
Dissolved oxygen	Check for damage to the probe	Each usage and replace as necessary

¹ It is noted that the field equipment listed in Table 4 is specific to the common field equipment that is routinely utilized at a site. It is possible that other field equipment may be utilized on-site (equipment may be rented or contractors may have different equipment). If this is the case, field equipment calibration and acceptance criteria/corrective action will be required to be addressed in the site-specific SAP. If OER acquires additional equipment, that equipment will be added to the table during revisions to the QAPP.

Table 5
Calibration and Corrective Action - Field Equipment¹

Instrument	Calibration Standards	Frequency Initial & Continuing Calibration	Acceptance Criteria	Corrective Action
GasTechtor 1314, TankTechtor	40% Hexane 400 ppm Toluene	Each day of usage	Adjustable to standard	Take the unit out of service until the filter or sensors can be replaced, and the unit meets the calibration standards.
Gas Tech GT 201, Thermo Gastech Innova	40% Hexane 50% Methane	Each day of usage	Adjustable to standard	Take the unit out of service until the filter or sensors can be replaced, and the unit meets the calibration standards.
MicroTIP	100 ppm Isobutylene	Each day of usage	Adjustable to standard	Take the unit out of service until the filter or lamp can be cleaned or replaced, and the unit meet the calibration standards
pH	Buffer solutions 4.00 ± 0.01, 7.00 ± 0.01 10.00 ± 0.01	Each day of usage	Adjustable to standard	Clean probe if dirty or replace probe if damaged, remove from service until the unit meets the calibration standard
Temperature	check against National Institute of Standards and Technology (NIST) traceable thermometer	Each day of usage	± 1.0 °F of NIST traceable thermometer	Clean temperature probe if dirty or replace if damaged, remove from service until the calibration standard is met
Conductivity	Potassium chloride 1,000 uS/cm ±1.0%	Each day of usage	Adjustable to standard	Clean probe if dirty or replace probe if damaged, remove from service until the unit meets the calibration standard
ORP	ORP Standard iron-salt solutions 100 mV	Each day of usage	Adjustable to standard	Clean probe if dirty or replace probe if damaged, remove from service until the unit meets the calibration standard
Dissolved oxygen	Water saturated air calibration	Each day of usage	Between 100 and 104% oxygen saturation in water-saturated air.	Clean probe if dirty or replace probe if damaged, remove from service until the unit meets the calibration standard

¹ It is noted that the field equipment listed in Table 5 is specific to the common field equipment that is routinely utilized at a site. It is possible that other field equipment may be utilized on-site (equipment may be rented or contractors may have different equipment). If this is the case, field equipment calibration and acceptance criteria/corrective action will be required to be addressed in the site-specific SAP. If OER acquires additional equipment, that equipment will be added to the table during revisions to the QAPP.

Table 6 – Data Evaluation¹
(page 1 of 4)

QC Element (Sample Type, Analysis, or Condition)	Type of Failure	Possible Cause²	Major PARCCs Affected³	Possible Effect on Data	Possible Worst Case Data Evaluation Scenario⁴
Chain of Custody	Chain broken or not kept	Missing signatures, missing seals, missing dates/times	Completeness	Incomplete data	Data not legally defensible
Sample Labeling	Sample labels missing, not attached to containers, or illegible	Failure to protect sample containers from moisture, failure to use appropriate marker, improper SOP	Representativeness Completeness	Incomplete data False positives False negatives	Invalidation of sample results
Sample Labeling	Samples mislabeled	Sampler error, improper SOP	Representativeness Completeness	Incomplete data False positives False negatives	Invalidation of sample results
Sample Containers	Plastic containers used for organic analytes	Sampler unaware of requirements to use glass, SAP not followed or incorrect, improper SOP	Representativeness Accuracy Completeness	False positives False negatives High or low bias Phthalate interference	Invalidation of sample results
Headspace	Air bubbles in aqueous VOC vials; visible headspace in soil VOC container	Poor sampling technique, caps not sealed tight, septum caps not used, dirt between rim and cap, soil not packed tight, improper SOP	Representativeness Accuracy Completeness	False negatives low bias	Invalidation of sample results
Preservation	No preservative or wrong pH	No preservative added, improper amount of preservative added, overfilling container with sample, improper SOP	Representativeness Accuracy Completeness	False negatives low bias	Invalidation of sample results, affects legal defensibility of data, Sample results greater than detection limit considered as minimum values only
Preservation	Wrong preservative	Improper SOP, failure to read SAP, SAP incorrect	Representativeness Accuracy Completeness	Incomplete data False positives False negatives	Invalidates or qualifies some or all of the sample results, affects legal defensibility of data,
Preservation	Samples not properly cooled, placed on ice	Insufficient ice used, shipping container not adequately insulated, transport time too long.	Representativeness Accuracy Completeness	False negatives low bias	Invalidation of sample results, affects legal defensibility of data, Sample results greater than detection limit considered as minimum values only

¹ Entries in the possible causes, PARCCs parameters affected, effect on data, and possible data evaluation columns assume that only type of failure occurred at any given time. The cumulative or synergistic affects of more than one failure type occurring at the same time makes data evaluation more complex and is beyond the scope of this table.

² The most common possible causes are listed.

³ PARCCs parameters most affected are listed, it is quite possible other PARCCs are affected.

⁴ All data evaluation must take into account the specific data quality objectives for a given project; therefore, it is possible that even suspect data may be used, depending upon the DQOs established for a project.

⁵ Generally, exceeding the holding times of a sample will result in false negatives and/or low bias; however, exceeding holding times on certain types of samples (carbonates, DO) may result in a false positive or high bias.

Furthermore, high bias and false positives can occur when degradation products of contaminants are also themselves analytes.

⁶ Method blanks are not appropriate for all analyses (i.e. pH, conductivity, % solids, total suspended solids, etc.)

⁷ When native sample concentrations are significantly greater than the effective spike concentration then the conclusion of a matrix effect is only tentative. As a general rule, the native sample concentration should be no more than four times higher than the matrix spike concentration for the matrix effect to be considered probably present.

⁸ Conventional sampling protocols for some analyte classes (VOCs, BTEX, GRO) prohibit sample mixing and splitting because it results in the loss of major fractions of the analytes. Field and QC samples for these analytes are appropriately collected as collocated sample pairs.

⁹ Use of field QA sample data to evaluate project sample data assumes that the field QA sample data is supported by a complete set of in-control laboratory quality control data.

Table 6 – Data Evaluation¹
(page 2 of 4)

QC Element (Sample Type, Analysis, or Condition)	Type of Failure	Possible Cause²	Major PARCCs Affected³	Possible Effect on Data	Possible Worst Case Data Evaluation Scenario⁴
Sample Filtration	Samples not filtered and preserved in field for dissolved metals	Sampler error, sampler unaware of requirement, improper SOP, failure to read SAP, SAP incorrect, filtration apparatus not available or damaged	Representativeness Accuracy Completeness	False positives False negatives High or low bias	Invalidation of sample results for dissolved metals
Holding Times ⁵	Holding times exceeded	Excessive analysis time, holding samples to long prior to shipment, shipping samples prior to a weekend or holiday, inappropriate shipping method	Representativeness Accuracy Completeness	False negatives Low Bias	Invalidation of sample results, affects legal defensibility of data, Sample results greater than detection limit considered as minimum values only
Analysis Method	Wrong method	Incorrect method listed on Chain of Custody, failure to read SAP, incorrect SAP, laboratory analyst error	Representativeness Accuracy Comparability Completeness	False negatives High or low bias	Invalidates or qualifies all or some of the sample results
Detection Limit	Detection limit too high	Insufficient sample, high dilution factor, wrong or inappropriate method	Comparability Completeness	Incomplete data False positives False negatives	Invalidation of sample results
Method Blank ⁶	Method blank absent	Lost during analysis, improper SOP	Representativeness Accuracy Completeness	False negatives Low sensitivity	Invalidation of sample results greater than detection limit, sample results less than detection limit are valid
Method Blank	Contamination greater than detection limit	Contaminated reagents or glassware, poor laboratory technique, improper SOP	Representativeness Accuracy Completeness	False positives High bias	Invalidates all sample results where method blank contamination is greater than 5% of sample concentration
Equipment rinsate blank	Contamination greater than the detection limit	Improper decontamination of field sampling equipment, contaminated rinsate water, containers, or preservatives	Representativeness Accuracy Completeness	False positives High bias	Invalidates all sample results where equipment blank contamination is greater than 5% of sample concentration

¹ Entries in the possible causes, PARCCs parameters affected, effect on data, and possible data evaluation columns assume that only type of failure occurred at any given time. The cumulative or synergistic affects of more than one failure type occurring at the same time makes data evaluation more complex and is beyond the scope of this table.

² The most common possible causes are listed.

³ PARCCs parameters most affected are listed, it is quite possible other PARCCs are affected.

⁴ All data evaluation must take into account the specific data quality objectives for a given project; therefore, it is possible that even suspect data may be used, depending upon the DQOs established for a project.

⁵ Generally, exceeding the holding times of a sample will result in false negatives and/or low bias; however, exceeding holding times on certain types of samples (carbonates, DO) may result in a false positive or high bias. Furthermore, high bias and false positives can occur when degradation products of contaminants are also themselves analytes.

⁶ Method blanks are not appropriate for all analyses (i.e. pH, conductivity, % solids, total suspended solids, etc.)

⁷ When native sample concentrations are significantly greater than the effective spike concentration then the conclusion of a matrix effect is only tentative. As a general rule, the native sample concentration should be no more than four times higher than the matrix spike concentration for the matrix effect to be considered probably present.

⁸ Conventional sampling protocols for some analyte classes (VOCs, BTEX, GRO) prohibit sample mixing and splitting because it results in the loss of major fractions of the analytes. Field and QC samples for these analytes are appropriately collected as collocated sample pairs.

⁹ Use of field QA sample data to evaluate project sample data assumes that the field QA sample data is supported by a complete set of in-control laboratory quality control data.

Table 6 – Data Evaluation¹
(page 3 of 4)

QC Element (Sample Type, Analysis, or Condition)	Type of Failure	Possible Cause²	Major PARCCs Affected³	Possible Effect on Data	Possible Worst Case Data Evaluation Scenario⁴
Trip Blank (applies to volatiles analysis only)	Trip Blank absent	Improper SOP, trip blank broken during shipment, trip blank lost during analysis	Representativeness Accuracy Completeness	False positives	Invalidation of sample results greater than detection limit, sample results less than detection limit are valid
Trip Blank (applies to volatiles analysis only)	Contamination greater than detection limit	Cross contamination during shipment or storage, contaminated reagent water, glassware, or preservative	Representativeness Accuracy Completeness	False positives High Bias	Invalidates all sample results were trip blank contamination is greater than 5% of sample concentration
Surrogate recoveries in method blank	Low recoveries	Method failure, improper spiking, degraded spiking solution, failed spiking device	Accuracy Completeness	False negatives Low bias	Invalidation of sample results
Surrogate recoveries in method blank	High recoveries	Method failure, improper spiking, degraded spiking solution, failed spiking device, contaminated reagents or glassware	Accuracy Completeness	High bias Possible false positives	Invalidation of sample results
Surrogate recoveries in samples	Low recoveries	Matrix effects, inappropriate method, method failure, improper spiking, degraded spiking solution, failed spiking device	Accuracy Completeness	False negatives Low bias	Qualifies all sample results (i.e. possible matrix effects), rejection of individual sample results
Surrogate recoveries in samples	High recoveries	Matrix effects, inappropriate method, method failure, improper spiking, degraded spiking solution, failed spiking device	Accuracy Completeness	High bias False positives	Qualifies all sample results (i.e. possible matrix effects), rejection of individual sample results
Matrix spike and/or matrix spike duplicate	Matrix spike and/or matrix spike duplicate missing	Insufficient sample, lost during analysis, improper SOP	Representativeness Accuracy Precision	False negatives High or low bias	Qualifies all sample results (i.e. no measure of matrix effects)
Matrix spike and/or matrix spike duplicate ⁷	Low recoveries	Matrix effects, inappropriate method, method failure, inadequate cleanup, inadequate background correction, failure to use method of standard additions, improper spiking, degraded spiking solution, failed spiking device	Accuracy	False negatives Low bias	Qualifies all sample results (i.e. possible matrix effects)

¹ Entries in the possible causes, PARCCs parameters affected, effect on data, and possible data evaluation columns assume that only type of failure occurred at any given time. The cumulative or synergistic affects of more than one failure type occurring at the same time makes data evaluation more complex and is beyond the scope of this table.

² The most common possible causes are listed.

³ PARCCs parameters most affected are listed, it is quite possible other PARCCs are affected.

⁴ All data evaluation must take into account the specific data quality objectives for a given project; therefore, it is possible that even suspect data may be used, depending upon the DQOs established for a project.

⁵ Generally, exceeding the holding times of a sample will result in false negatives and/or low bias; however, exceeding holding times on certain types of samples (carbonates, DO) may result in a false positive or high bias. Furthermore, high bias and false positives can occur when degradation products of contaminants are also themselves analytes.

⁶ Method blanks are not appropriate for all analyses (i.e. pH, conductivity, % solids, total suspended solids, etc.)

⁷ When native sample concentrations are significantly greater than the effective spike concentration then the conclusion of a matrix effect is only tentative. As a general rule, the native sample concentration should be no more than four times higher than the matrix spike concentration for the matrix effect to be considered probably present.

⁸ Conventional sampling protocols for some analyte classes (VOCs, BTEX, GRO) prohibit sample mixing and splitting because it results in the loss of major fractions of the analytes. Field and QC samples for these analytes are appropriately collected as collocated sample pairs.

⁹ Use of field QA sample data to evaluate project sample data assumes that the field QA sample data is supported by a complete set of in-control laboratory quality control data.

Table 6 – Data Evaluation¹
(page 4 of 4)

QC Element (Sample Type, Analysis, or Condition)	Type of Failure	Possible Cause²	Major PARCCs Affected³	Possible Effect on Data	Possible Worst Case Data Evaluation Scenario⁴
Matrix spike and/or matrix spike duplicate	High recoveries	Matrix effects, inappropriate method, method failure, inadequate cleanup, inadequate background correction, failure to use method of standard additions, improper spiking, degraded spiking solution, failed spiking device, contaminated reagents or glassware	Accuracy Precision	False positives High bias	Qualifies all sample results greater than detection limit (i.e. possible matrix effects)
Matrix spike and/or matrix spike duplicate	High relative percent difference	Sample is not homogeneous, inadequate sample mixing in laboratory, samples misidentified, method failure, improper spiking, degraded spiking solution, failed spiking device, contaminated reagents or glassware	Representativeness Precision	Non-representative sample Poor precision	Qualifies all sample results greater than the detection limit (i.e. possibly highly variable results)
Dilution Factors	Extremely high dilution factors	High concentrations of interferences or analytes, inappropriate method	Accuracy Comparability Completeness	False negatives Poor accuracy Low sensitivity	Invalidation of samples with high dilution factors, may qualify samples results as estimated
Field Quality Control Samples ⁸	Field and QC sample concentrations do not compare within acceptable limits	Samples were not homogeneous, insufficient mixing in the field, samples not split but collocated, insufficient mixing in lab	Representativeness Precision	Non-representative sample Poor precision High or low bias	Qualifies all sample results greater than detection limit (i.e. possible highly variable results), Sample results less than detection limit are valid
Field Quality Assurance Samples ⁹	Quality assurance sample results do not agree with project and/or QC sample results	Improper SOP (QA and primary lab used different analytical methods), inadequate cleanup, inadequate background correction, laboratory contamination, preservative problems, method failure, sample misidentification, samples were not homogeneous	Comparability Completeness Representativeness Precision	Non-representative sample False positives False negatives High or low bias	Qualifies or invalidates all or part of the data set.

¹ Entries in the possible causes, PARCCs parameters affected, effect on data, and possible data evaluation columns assume that only type of failure occurred at any given time. The cumulative or synergistic affects of more than one failure type occurring at the same time makes data evaluation more complex and is beyond the scope of this table.

² The most common possible causes are listed.

³ PARCCs parameters most affected are listed, it is quite possible other PARCCs are affected.

⁴ All data evaluation must take into account the specific data quality objectives for a given project; therefore, it is possible that even suspect data may be used, depending upon the DQOs established for a project.

⁵ Generally, exceeding the holding times of a sample will result in false negatives and/or low bias; however, exceeding holding times on certain types of samples (carbonates, DO) may result in a false positive or high bias.

Furthermore, high bias and false positives can occur when degradation products of contaminants are also themselves analytes.

⁶ Method blanks are not appropriate for all analyses (i.e. pH, conductivity, % solids, total suspended solids, etc.)

⁷ When native sample concentrations are significantly greater than the effective spike concentration then the conclusion of a matrix effect is only tentative. As a general rule, the native sample concentration should be no more than four times higher than the matrix spike concentration for the matrix effect to be considered probably present.

⁸ Conventional sampling protocols for some analyte classes (VOCs, BTEX, GRO) prohibit sample mixing and splitting because it results in the loss of major fractions of the analytes. Field and QC samples for these analytes are appropriately collected as collocated sample pairs.

⁹ Use of field QA sample data to evaluate project sample data assumes that the field QA sample data is supported by a complete set of in-control laboratory quality control data.

APPENDIX A

Typical List of Chemicals of Concern

LUST Program Action Levels

Parameter	Groundwater		Soil	
TPH-GRO	1.0 mg/l	DEP Action Level	100 mg/kg	DEP Action Level
TPH-DRO	1.0 mg/l	DEP Action Level	100 mg/kg	DEP Action Level
TPH-ORO	1.0 mg/l	DEP Action Level	100 mg/kg	DEP Action Level
Benzene	5.0 ug/l	46-CSR-12 ²	50 ug/kg	DEP Action Level
Ethylbenzene	0.7 mg/l	46-CSR-12 ²	NA ²	--
Toluene	1.0 mg/l	46-CSR-12 ²	NA ²	--
Total Xylenes	10.0 mg/l	46-CSR-12 ²	NA ²	--
Total BTEX	NA ²	--	10 mg/kg	DEP Action Level
Total PAHs	NA ²	--	1 mg/kg	DEP Action Level
MTBE	20 ug/l	DEP Action Level	NA	--
Naphthalene	20 ug/l	Health Based Limit	NA	--
Dissolved Lead	15 ug/l	46-CSR-12	NA	--

¹ Those limits set by Title 46, Series 12, *The Requirements Governing Groundwater Standards*, are set by the WV Legislature and, as such, cannot be deviated from. However, those limits that are DEP Action levels are guidance concentrations used by our office and can be adjusted site by site, as needed.

² NA = Not applicable

Voluntary Remediation Program: Table 60-3B
(Effective June 5, 2009)

CONTAMINANT	CAS No.	Residential Soil^{1,4} (mg/kg)	Industrial Soil^{1,4} (mg/kg)	Ground Water^{2,4} (ug/L)	Migration to Groundwater^{3,4} (mg/kg)
Acetaldehyde	75-07-0	1.1E+01	1.6E+02	1.7E+00	8.3E-03
Acetochlor	34256-82-1	1.2E+03	1.8E+04	7.3E+02	8.1E+00
Acetone	67-64-1	1.4E+04	5.6E+04	5.5E+03	2.2E+01
Acetonitrile	75-05-8	6.2E+02	2.0E+03	1.2E+02	5.7E-01
Acetophenone	98-86-2	4.1E+03	2.5E+04	6.1E+02	3.2E+00
Acrolein	107-02-8	1.0E-01	3.4E-01	4.2E-02	2.0E-04
Acrylamide	79-06-1	1.1E-01	5.4E+00	1.5E-02	7.5E-05
Acrylonitrile	107-13-1	2.1E-01	5.2E+00	3.9E-02	1.6E-04
Alachlor	15972-60-8	6.0E+00	3.1E+02	2.0E+00	1.7E-02
Alar	1596-84-5	9.2E+03	1.3E+05	5.5E+03	2.4E+01
Aldicarb	116-06-3	6.1E+01	8.8E+02	3.7E+01	2.1E-01
Aldicarb sulfone	1646-88-4	6.1E+01	8.8E+02	3.7E+01	1.5E-01
Aldrin	309-00-2	2.9E-02	1.5E+00	4.0E-03	3.9E-01
Aluminum	7429-90-5	7.5E+04	1.0E+06	3.7E+04	1.1E+06
4-Aminopyridine	504-24-5	1.2E+00	1.8E+01	7.3E-01	4.2E-03
Aniline	62-53-3	8.5E+01	4.3E+03	1.2E+01	1.4E-01
Antimony and compounds	7440-36-0	3.1E+01	8.2E+02	6.0E+00	5.4E+00
Antimony trioxide	1309-64	3.1E+01	8.2E+02	1.5E+01	
Arsenic	7440-38-2	3.9E-01	2.7E+01	1.0E+01	5.8E+01
Assure	76578-14-8	5.5E+02	7.9E+03	3.3E+02	7.3E+01
Atrazine	1912-24-9	2.2E+00	1.1E+02	3.0E+00	8.6E-02
Azobenzene	103-33-3	3.7E+00	1.5E+02	1.0E-01	5.9E-03
Barium and compounds	7440-39-3	1.5E+04	2.9E+05	2.0E+03	1.6E+03
Baygon	114-26-1	2.4E+02	3.5E+03	1.5E+02	8.4E-01
Baythroid	68359-37-5	1.5E+03	2.2E+04	9.1E+02	6.5E+03
Bentazon	25057-89-0	1.8E+03	2.6E+04	1.1E+03	6.0 E+00
Benzaldehyde	100-52-7	1.7E+03	1.7E+03	6.1E+02	3.2E+00
Benzene	71-43-2	6.6E-01	1.5E+01	5.0E+00	3.4E-02
Benzidine	92-87-5	2.1E-03	1.1E-01	2.9E-04	3.3E-05
Benzoic acid	65-85-0	2.4E+05	1.0E+06	1.5E+05	5.9E+02
Benzyl alcohol	100-51-6	3.1E+04	4.4E+05	1.8E+04	1.5E+02
Benzyl chloride	100-44-7	8.9E-01	2.3E+01	6.6E-02	4.0E-04
Beryllium and compounds	7440-41-7	1.5E+02	3.7E+03	4.0E+00	6.3E+01
1,1-Biphenyl	92-52-4	3.0E+03	3.0E+04	3.0E+02	9.6E+01
Bis(2-chloroethyl)ether	111-44-4	2.1E-01	6.0E+00	8.0E+01	5.6E-01
Bis(2-chloroisopropyl)ether	108-60-1	2.9E+00	8.1E+01	2.7E-01	1.8E-03
Bis(chloromethyl)ether	542-88-1	1.9E-04	4.4E-03	5.2E-05	2.1E-07
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	3.5E+01	1.8E+03	6.0E+00	3.6E+03

Voluntary Remediation Program: Table 60-3B
(Effective June 5, 2009)

CONTAMINANT	CAS No.	Residential Soil ^{1,4} (mg/kg)	Industrial Soil ^{1,4} (mg/kg)	Ground Water ^{2,4} (ug/L)	Migration to Groundwater ^{3,4} (mg/kg)
Bromodichloromethane	75-27-4	1.0E+00	2.4E+01	1.8E-01	1.5E-03
Bromoform (tribromomethane)	75-25-2	6.1E+01	3.1E+03	8.5E+00	6.4E-02
Bromomethane	74-83-9	3.9E+00	1.3E+01	8.7E+00	4.2E-02
Bromophos	2104-96-3	3.1E+02	4.4E+03	1.8E+02	1.5E+01
1,3-Butadiene	106-99-0	5.9E-02	1.3E+00	1.2E-01	2.6E-03
1-Butanol	71-36-3	6.1E+03	8.8E+04	3.7E+03	1.6E+01
Butylate	2008-41-5	3.1E+03	4.4E+04	1.8E+03	5.2E+01
n-Butylbenzene	104-51-8	8.2E+01	8.2E+01	6.1E+01	7.2E+00
sec-Butylbenzene	135-98-8	7.8E+01	7.8E+01	6.1E+01	5.6E+00
tert-Butylbenzene	98-06-6	1.3E+02	1.4E+02	6.1E+01	5.5E+00
Butyl benzyl phthalate	85-68-7	1.2E+04	1.8E+05	7.3E+03	1.7E+04
Cadmium and compounds	7440-43-9	3.9E+01	1.0E+03	5.0E+00	7.5E+00
Caprolactam	105-60-2	3.1E+04	4.4E+05	1.8E+04	1.1E+02
Carbaryl	63-25-2	6.1E+03	8.8E+04	3.7E+03	3.0E+01
Carbazole	86-74-8	2.4E+01	1.2E+03	3.4E+00	4.7E-01
Carbon disulfide	75-15-0	3.6E+02	4.7E+02	1.0E+03	8.3E+00
Carbon tetrachloride	56-23-5	2.4E-01	5.3E+00	5.0E+00	6.1E-02
Carbosulfan	55285-14-8	6.1E+02	8.8E+03	3.7E+02	2.2E+02
Chloranil	118-75-2	1.2E+00	6.1E+01	1.7E-01	7.4E-04
Chlordane	12789-03-6	1.6E+00	1.1E+02	2.0E+00	9.6E+00
Chloroacetic acid	79-11-8	1.2E+02	1.8E+03	7.3E+01	3.0E-01
4-Chloroaniline	106-47-8	2.4E+02	3.5E+03	1.5E+02	9.7E-01
Chlorobenzene	108-90-7	1.3E+02	3.1E+02	1.0E+02	1.3E+00
Chlorobenzilate	510-15-6	1.8E+00	9.1E+01	2.5E-01	2.7E-02
p-Chlorobenzoic acid	74-11-3	1.2E+04	1.8E+05	7.3E+03	3.6E+01
2-Chloro-1,3-butadiene	126-99-8	3.6E+00	1.2E+01	1.4E+01	1.2E-01
1-Chlorobutane	109-69-3	7.1E+01	2.4E+02	2.4E+02	2.0E+00
Chloroethane	75-00-3	3.0E+00	6.5E+01	3.9E+00	2.1E-02
Chloroform	67-66-3	2.5E-01	5.2E+00	1.7E-01	1.1E-03
Chloromethane	74-87-3	4.8E+01	1.6E+02	1.9E+02	1.3E-00
4-Chloro-2-methylaniline	95-69-2	8.4E-01	4.3E+01	1.2E-01	1.0E-03
beta-Chloronaphthalene	91-58-7	3.9E+03	2.7E+04	4.9E+02	3.2E+01
o-Chloronitrobenzene	88-73-3	1.4E+00	4.5E+00	1.5E-01	9.6E-04
p-Chloronitrobenzene	100-00-5	1.0E+01	3.8E+01	1.2E-00	7.9E-03
2-Chlorophenol	95-57-8	6.4E+01	2.4E+02	3.0E+01	6.1E-01
2-Chloropropane	75-29-6	1.8E+02	6.0E+02	2.1E+02	1.3E+00
o-Chlorotoluene	95-49-8	1.6E+02	2.5E+02	1.2E+02	1.3E+00
Chlorpyrifos	2921-88-2	1.8E+02	2.6E+03	1.1E+02	6.3E+01
Chlorpyrifos-methyl	5598-13-0	6.1E+02	8.8E+03	3.7E+02	3.1E+01
Chromium III	16065-83-1	1.2E+05	1.0E+06	5.5E+04	2.0E+09
Chromium VI	18540-29-9	2.1E+02	4.5E+03	1.1E+02	4.2E+01

Voluntary Remediation Program: Table 60-3B
(Effective June 5, 2009)

CONTAMINANT	CAS No.	Residential Soil ^{1,4} (mg/kg)	Industrial Soil ^{1,4} (mg/kg)	Ground Water ^{2,4} (ug/L)	Migration to Groundwater ^{3,4} (mg/kg)
Cobalt	7440-48-4	9.0E+02	1.9E+04	7.3E+02	6.6E+02
Copper and compounds	7440-50-8	3.1E+03	8.2E+04	1.5E+03	1.0E+03
Crotonaldehyde	123-73-9	5.2E-03	1.1E-01	5.9E-03	3.2E-04
Cyanazine	21725-46-2	5.8E-01	2.9E+01	8.0E-02	5.3E-04
Cyanide and compounds	74-90-8	1.1E+01	3.5E+01	2.0E+02	4.0E+01
Cyanogen	460-19-5	23E+03	2.3E+03	1.5E+03	7.9E+00
Cyanogen bromide	506-68-3	7.0E+03	1.8E+05	3.3E+03	1.8E+01
Cyclohexane	110-82-7	6.8E+01	6.8E+0	1.2E+04	3.1E+02
Cyclohexanone	108-94-1	3.1E+05	1.0E+06	1.8E+05	1.2E+03
Cyhalothrin/Karate	68085-85-8	3.1E+02	4.4E+03	1.8E+02	3.5E+03
Cypermethrin	52315-07-8	6.1E+02	8.8E+03	3.7E+02	1.6E+03
Dacthal	1861-32-1	6.1E+02	8.8E+03	3.7E+02	5.6E+00
Dalapon	75-99-0	1.8E+03	2.6E+04	2.0E+02	1E+00
DDD	72-54-8	2.4E+00	1.7E+02	2.8E-01	1.1E+01
DDE	72-55-9	1.7E+00	1.2E+02	2.0E-01	3.5E+01
DDT	50-29-3	1.7E+00	1.2E+02	2.0E-01	2.1E+01
Diazinon	333-41-5	5.5E+01	7.9E+02	3.3E+01	4.3E-01
Dibenzofuran	132-64-9	7.8E+01	2.0E+03	3.7E+01	1.1E+01
1,4-Dibromobenzene	106-37-6	6.1E+02	8.8E+03	3.7E+02	7.8E+00
Dibromochloromethane	124-48-1	7.6E+00	6.8E+02	8.0E-01	1.8E-02
1,2-Dibromo-3-chloropropane	96-12-8	8.0E-01	7.1E+01	2.0E-01	1.0E-03
1,2-Dibromoethane	106-93-4	2.7E-02	6.2E-01	5.0E-02	2.6E-04
Dibutyl phthalate	84-74-2	6.1E+03	8.8E+04	3.7E+03	5.0E+03
Dicamba	1918-00-9	1.8E+03	2.6E+04	1.1E+03	4.5E+00
1,2-Dichlorobenzene	95-50-1	1.5E+02	1.5E+02	6.0E+02	1.2E+01
1,3-Dichlorobenzene	541-73-1	3E+01	1.3E+0	6.0E+02	1.2E+01
1,4-Dichlorobenzene	106-46-7	2.0E+00	4.5E+01	7.5E+01	2.2E+00
3,3-Dichlorobenzidine	91-94-1	1.1E+00	5.5E+01	1.5E-01	4.9E-03
1,4-Dichloro-2-butene	764-41-0	7.9E-03	1.8E-01	1.2E-03	7.2E-06
Dichlorodifluoromethane	75-71-8	9.4E+01	1.9E+02	3.9E+02	5.3E+00
1,1-Dichloroethane	75-34-3	6.1E+02	1.6E+03	9.1E+02	5.9E+00
1,2-Dichloroethane	107-06-2	3.5E-01	7.7E+00	5.0E+00	2.8E-02
1,1-Dichloroethylene	75-35-4	1.3E+02	4.3E+02	7.0E+00	5.9E-02
1,2-Dichloroethylene (cis)	156-59-2	4.3E+01	1.5E+02	7.0E+01	4.0E-01
1,2-Dichloroethylene (trans)	156-60-5	5.4E+01	1.8E+02	1.2E+02	6.2E-01
2,4-Dichlorophenol	120-83-2	1.8E+02	2.6E+03	1.1E+02	1.1E+00
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	94-82-6	4.9E+02	7.0E+03	2.9E+02	2.3E+00
2,4-Dichlorophenoxyacetic Acid (2,4-D)	94-75-7	6.9E+02	1.2E+04	7E+02	1.7E+00
1,2-Dichloropropane	78-87-5	6.4E-01	1.4E+01	5.0E+00	3.0E-02
1,3-Dichloropropene	542-75-6	7.0E-01	1.6E+01	4.0E-01	2.5E-03
2,3-Dichloropropanol	616-23-9	1.8E+02	2.6E+03	1.1E+02	4.6E-01
Dichlorvos	62-73-7	1.7E+00	8.5E+01	2.3E-01	1.1E-03

Voluntary Remediation Program: Table 60-3B
(Effective June 5, 2009)

CONTAMINANT	CAS No.	Residential Soil^{1,4} (mg/kg)	Industrial Soil^{1,4} (mg/kg)	Ground Water^{2,4} (ug/L)	Migration to Groundwater^{3,4} (mg/kg)
Dicofol	115-32-2	1.1E+00	5.6E+01	1.5E-01	1.9E-02
Dicyclopentadiene	77-73-6	1.9E+01	6.2E+01	1.4E+01	3.8E-01
Dieldrin	60-57-1	3.0E-02	1.5E+00	4.2E-03	3.6E-03
Diethylene glycol, monobutyl ether	112-34-5	6.1E+02	8.8E+03	3.7E+02	1.6E+00
Diethylene glycol, monoethyl ether	111-90-0	3.7E+03	5.2E+04	2.2E+03	8.8E+00
Di(2-ethylhexyl)adipate	103-23-1	4.0E+02	2.1E+04	4.0E+02	7.8E+02
Diethyl phthalate	84-66-2	4.9E+04	7.0E+05	2.9E+04	4.5E+02
Diethylstilbestrol	56-53-1	1.0E-04	5.2E-03	1.4E-05	3.3E-04
Difenzoquat (Avenge)	43222-48-6	4.9E+03	7.0E+04	2.9E+03	1.4E+04
1,1-Difluoroethane	75-37-6	1.1E+03	1.1E+03	8.3E+04	5.7E+02
Diisopropyl methylphosphonate	1445-75-6	3.9E+02	3.9E+02	2.9E+03	1.5E+01
3,3'-Dimethoxybenzidine	119-90-4	3.5E+01	1.8E+03	4.8E+00	3.0E-01
Dimethylamine	124-40-3	7.9E-02	2.6E-01	4.2E-02	1.4E-04
N-N-Dimethylaniline	121-69-7	4.4E+01	2.0E+02	1.2E+01	8.6E-02
2,4-Dimethylaniline	95-68-1	6.5E-01	3.3E+01	9.0E-02	7.9E-04
2,4-Dimethylaniline hydrochloride	21436-96-4	8.4E-01	4.3E+01	1.1E-01	1.0E-03
3,3'-Dimethylbenzidine	119-93-7	2.1E-01	1.1E+01	2.9E-02	8.9E-03
2,4-Dimethylphenol	105-67-9	1.2E+03	1.8E+04	7.3E+02	9.0E+00
2,6-Dimethylphenol	576-26-1	3.7E+01	5.3E+02	2.2E+01	7.3E-01
3,4-Dimethylphenol	95-65-8	6.1E+01	8.8E+02	3.7E+01	1.2E+00
Dimethyl phthalate	131-11-3	6.1E+05	1.0E+06	3.7E+05	2.0E+03
4,6-Dinitro-o-cyclohexyl phenol	131-89-5	1.2E+02	1.8E+03	7.3E+01	4.1E+01
1,2-Dinitrobenzene	528-29-0	6.1E+00	8.8E+01	3.7E+00	4.7E-02
1,3-Dinitrobenzene	99-65-0	6.1E+00	8.8E+01	3.7E+00	3.7E-02
1,4-Dinitrobenzene	100-25-4	6.1E+00	8.8E+01	3.7E+00	4.7E-02
2,4-Dinitrophenol	51-28-5	1.2E+02	1.8E+03	7.3E+01	2.9E-01
Dinitrotoluene mixture	25321-14-6	7.1E-01	3.6E+01	9.9E-02	1.9E-03
2,4-Dinitrotoluene	121-14-2	1.2E+02	1.8E+03	7.3E+01	5.7E-01
2,6-Dinitrotoluene	606-20-2	6.1E+01	8.9E+02	3.7E+01	2.5E-01
Dinoseb	88-85-7	6.1E+01	8.8E+02	7.0E+00	3.3E-02
1,4-Dioxane	123-91-1	4.4E+01	2.2E+03	6.1E+00	2.6E-02
Diphenylamine	122-39-4	1.5E+03	2.2E+04	9.1E+02	2.5E+01
1,2-Diphenylhydrazine	122-66-7	6.1E-01	3.1E+01	8.4E-02	2.6E-03
Diquat	85-00-7	1.3E+02	1.9E+03	2.0E+01	8.2E-02
Disulfoton	298-04-4	3.5E+01	3.5E+01	1.5E+00	6.4E-02
1,4-Dithiane	505-29-3	6.1E+02	8.8E+03	3.7E+02	3.9E+00
Diuron	330-54-1	1.2E+02	1.8E+03	7.3E+01	1.2E+00
Endosulfan	115-29-7	3.7E+02	5.3E+03	2.2E+02	2.0E+01
Endothall	145-73-3	1.2E+03	1.8E+04	1.0E+02	4.4E-01
Endrin	72-20-8	1.8E+01	2.6E+02	2.0E+00	9.9E-01

Voluntary Remediation Program: Table 60-3B
(Effective June 5, 2009)

CONTAMINANT	CAS No.	Residential Soil^{1,4} (mg/kg)	Industrial Soil^{1,4} (mg/kg)	Ground Water^{2,4} (ug/L)	Migration to Groundwater^{3,4} (mg/kg)
Epichlorohydrin	106-89-8	7.8E+00	2.6E+01	2.1E+00	8.6E-03
Ethion	563-12-2	3.1E+01	4.4E+02	1.8E+01	6.4E+00
2-Ethoxyethanol	110-80-5	2.4E+04	3.5E+05	1.5E+04	6.5E+01
Ethyl acetate	141-78-6	1.9E+04	2.6E+04	5.5E+03	3.5E+01
Ethylbenzene	100-41-4	1.1E+02	1.1E+02	7.0E+02	8.9E+00
Ethylene diamine	107-15-3	5.5E+03	7.9E+04	3.3E+03	1.6E+01
Ethylene glycol	107-21-1	1.2E+05	1.0E+06	7.3E+04	3.0E+02
Ethylene glycol, monobutyl ether	111-76-2	3.1E+04	4.4E+05	1.8E+04	7.4E+01
Ethylene thiourea (ETU)	96-45-7	4.4E+00	7.0E+01	6.1E-01	2.6E-03
Ethyl ether	60-29-7	2.3E+03	2.3E+03	1.2E+03	5.5E+00
Ethyl methacrylate	97-63-2	5.5E+01	5.5E+01	5.5E+02	3.0E+01
Fenamiphos	22224-92-6	1.5E+01	2.2E+02	9.1E+00	1.6E-01
Fluometuron	2164-17-2	7.9E+02	1.1E+04	4.7E+02	8.8E+00
Fluoride	16984-48-8	3.7E+03	5.3E+04	4.0E+03	1.2E+04
Fomesafen	72178-02-0	2.6E+00	1.3E+02	3.5E-01	1.6E-01
Fonofos	944-22-9	1.2E+02	1.8E+03	7.3E+01	3.5E+00
Formaldehyde	50-00-0	1.2E+04	1.8E+05	7.3E+03	3.0E+01
Formic Acid	64-18-6	1.1E+05	1.0E+06	7.3E+04	2.9E+02
Furan	110-00-9	2.5E+00	8.6E+00	6.1E+00	3.0E-02
Furazolidone	67-45-8	1.3E-01	6.5E+00	1.8E-02	6.6E-04
Furfural	98-01-1	1.8E+02	2.6E+03	1.1E+02	4.6E-01
Glycidaldehyde	765-34-4	2.4E+01	3.5E+02	1.5E+01	5.9E-02
Glyphosate	1071-83-6	6.1E+03	8.8E+04	7.0E+02	1.0E+02
Heptachlor	76-44-8	1.1E-01	5.5E+00	4.0E-01	2.3E+01
Heptachlor epoxide	1024-57-3	5.3E-02	2.7E+00	2.0E-01	6.7E-01
Hexabromobenzene	87-82-1	1.2E+02	1.8E+03	7.3E+01	1.0E+01
Hexachlorobenzene	118-74-1	3.0E-01	1.5E+01	1.0E+00	2.2E+00
Hexachlorobutadiene	87-68-3	6.2E+00	3.2E+02	8.6E-01	1.9E+00
HCH (alpha)	319-84-6	9.0E-02	5.9E+00	1.1E-02	5.7E-04
HCH (beta)	319-85-7	3.2E-01	2.1E+01	3.7E-02	2.0E-03
HCH (gamma) Lindane	58-89-9	4.4E-01	2.9E+01	2.0E-01	9.4E-03
HCH-technical	608-73-1	3.2E-01	2.1E+01	3.7E-02	5.2E-03
Hexachlorocyclopentadiene	77-47-4	3.7E+02	5.2E+03	5.0E+01	4.0E+02
Hexachlorodibenzo-p-dioxin mixture (HxCDD)	19408-74-3	7.8E-05	4.0E-03	1.1E-05	1.8E-04
Hexachloroethane	67-72-1	3.5E+01	8.8E+02	4.8E+00	3.6E-01
Hexachlorophene	70-30-4	1.8E+01	2.6E+02	1.1E+01	2.0E+03
1,6-Hexamethylene diisocyanate	822-06-0	1.7E-00	5.5E+00	2.1E-02	5.0E-03
n-Hexane	110-54-3	4.3E+01	4.3E+01	1.5E+03	7.0E+01
Hexazinone	51235-04-2	2.0E+03	2.9E+04	1.2E+03	3.4E+01

Voluntary Remediation Program: Table 60-3B
(Effective June 5, 2009)

CONTAMINANT	CAS No.	Residential Soil^{1,4} (mg/kg)	Industrial Soil^{1,4} (mg/kg)	Ground Water^{2,4} (ug/L)	Migration to Groundwater^{3,4} (mg/kg)
HMX	2691-41-0	3.8E+03	9.5E+04	1.8E+03	1.4E+02
Hydrazine	302-01-2	1.6E-01	8.2E+00	2.2E-02	9.1E-05
Hydrogen sulfide	7783-06-4	2.3E+02	6.1E+03	1.1E+02	
p-Hydroquinone	123-31-9	8.7E+00	4.4E+02	1.2E+00	2.6E-02
Iron	7439-89-6	5.5E+04	1.0E+06	2.6E+04	1.3E+04
Isobutanol	78-83-1	1.3E+04	2.7E+04	1.8E+03	1.2E+01
Isophorone	78-59-1	5.1E+02	2.6E+04	7.1E+01	4.2E-01
Isopropalin	33820-53-0	9.2E+02	1.3E+04	5.5E+02	1.5E+02
Isopropyl methyl phosphonic acid	1832-54-8	6.1E+03	8.8E+04	3.7E+03	1.5E+01
Lead (*)	7439-92-1	4.0E+02	1.0E+03	1.5E+01	2.7E+02
Lead (tetraethyl)	78-00-2	6.1E-03	8.8E-02	3.7E-03	9.2E-04
Lithium	7439-93-2	1.6E+03	4.1E+04	7.3E+02	4.4E+03
Malathion	121-75-5	1.2E+03	1.8E+04	7.3E+02	8.1E+00
Maleic anhydride	108-31-6	6.1E+03	8.8E+04	3.7E+03	1.5E+01
Manganese (non-food)	7439-96-5	3.3E+03	4.8E+04	1.7E+03	2.2E+03
Mephosfolan	950-10-7	5.5E+00	7.9E+01	3.3E+00	7.9E-02
Mepiquat	24307-26-4	1.8E+03	2.6E+04	1.1E+03	1.2E+01
Mercury, inorganic		2.3E+01	6.1E+02	2.0E+00	2.1E+00
Mercury (methyl)	22967-92-6	6.1E+00	8.8E+01	3.7E+00	
Methacrylonitrile	126-98-7	2.1E+00	8.8E+00	1.0E+00	4.2E-03
Methanol	67-56-1	3.1E+04	4.4E+05	1.8E+04	7.5E+01
Methidathion	950-37-8	6.1E+01	8.8E+02	3.7E+01	1.6E-01
Methoxychlor	72-43-5	3.1E+02	4.4E+03	4.0E+01	1.6E+02
Methyl acetate	79-20-9	2.2E+04	9.6E+04	6.1E+03	2.5E+01
Methyl acrylate	96-33-3	7.0E+01	1.6E+02	1.8E+02	1.0E+01
Methyl tertiary butyl ether (MTBE)	1634-04-4	1.5E+02	1.1E+04	1.7E+01	7.1E-02
2-Methylaniline (o-toluidine)	95-53-4	2.0E+00	1.0E+02	2.8E-01	5.7E-03
2-Methyl-4-chlorophenoxyacetic acid	94-74-6	3.1E+01	4.4E+02	1.8E+01	9.4E-02
4-(2-Methyl-4-chlorophenoxy) butyric acid	94-81-5	6.1E+02	8.8E+03	3.7E+02	2.9E+00
2-(2-Methyl-4-chlorophenoxy) propionic acid	93-65-2	6.1E+01	8.8E+02	3.7E+01	2.2E-01
Methylcyclohexane	108-87-2	8.5E+01	8.5E+01	6.3E+03	7.6E+02
4,4'-Methylenebisbenzeneamine	101-77-9	1.9E+00	9.9E+01	2.7E-01	5.4E-02
4,4'-Methylene bis(2-chloroaniline)	101-14-4	4.9E+00	2.5E+02	6.7E-01	3.7E-01
4,4'-Methylene bis(N,N'-dimethyl)aniline	101-61-1	1.1E+01	5.4E+02	1.5E+00	8.7E-01
Methylene bromide	74-95-3	6.7E+01	2.4E+02	6.1E+01	3.1E-01
Methylene chloride	75-09-2	8.9E+00	2.1E+02	5.0E+00	2.3E-02
4,4'-Methylenediphenyl isocyanate	101-68-8	3.5E+05	1.0E+06		
Methyl ethyl ketone	78-93-3	2.2E+04	5.6E+04	7.0E+03	2.9E+01
Methyl isobutyl ketone	108-10-1	8.9E+03	8.9E+03	6.3E+03	5.9E+01
Methyl methacrylate	80-62-6	2.2E+03	3.4E+03	1.4E+03	6.5E+00
2-Methyl-5-nitroaniline	99-55-8	1.5E+01	7.5E+02	2.0E+00	1.5E-02

Voluntary Remediation Program: Table 60-3B
(Effective June 5, 2009)

CONTAMINANT	CAS No.	Residential Soil ^{1,4} (mg/kg)	Industrial Soil ^{1,4} (mg/kg)	Ground Water ^{2,4} (ug/L)	Migration to Groundwater ^{3,4} (mg/kg)
Methyl parathion	298-00-0	1.5E+01	2.2E+02	9.1E+00	8.5E-02
2-Methylphenol	95-48-7	3.1E+03	4.4E+04	1.8E+03	1.4E+01
3-Methylphenol	108-39-4	3.1E+03	4.4E+04	1.8E+03	3.9E+01
4-Methylphenol	106-44-5	3.1E+02	4.4E+03	1.8E+02	3.9E+00
Methyl styrene (mixture)	25013-15-4	1.3E+02	2.8E+02	6.0E+01	1.1E+00
Methyl styrene (alpha)	98-83-9	2.8E+02	2.8E+03	4.3E+02	7.9E+00
Metolaclor (Dual)	51218-45-2	9.2E+03	1.3E+05	5.5E+03	8.6E+01
Metribuzin	21087-64-9	1.5E+03	2.2E+04	9.1E+02	4.7E+01
Mirex	2385-85-5	2.7E-01	1.4E+01	3.7E-02	7.1E-01
Molybdenum	7439-98-7	3.9E+02	1.0E+04	1.8E+02	7.4E+01
Monochloramine	10599-90-3	6.1E+03	8.8E+04	3.7E+03	
Naled	300-76-5	1.2E+02	1.8E+03	7.3E+01	5.7E-01
Nickel and compounds	7440-02-0	1.6E+03	4.1E+04	1.0E+02	1.3E+02
Nitrate	14797-55-8	1.3E+05	1.0E+06	1.0E+04	
Nitrite	14797-65-0	7.8E+03	2.0E+05	1.0E+03	
2-Nitroaniline	88-74-4	1.8E+02	5.0E+01	1.1E+02	5.6E-01
Nitrobenzene	98-95-3	2.0E+01	1.1E+02	3.4E+00	2.2E-02
Nitrofurantoin	67-20-9	4.3E+03	6.2E+04	2.6E+03	3.7E+01
Nitrofurazone	59-87-0	3.2E-01	1.6E+01	4.5E-02	8.5E-04
Nitroglycerin	55-63-0	6.1E+00	8E+01	3.7E+00	3.4E-02
4-Nitrophenol	100-02-7	4.9E+02	7.0E+03	2.9E+02	1.7E+00
2-Nitropropane	79-46-9	7.6E-03	1.8E-01	1.2E-03	5.7E-06
N-Nitrosodi-n-butylamine	924-16-3	2.4E-02	6.2E-01	2.0E-03	2.9E-05
N-Nitrosodiethanolamine	1116-54-7	1.7E-01	8.8E+00	2.4E-02	9.7E-05
N-Nitrosodiethylamine	55-18-5	3.2E-03	1.6E-01	4.5E-04	2.3E-06
N-Nitrosodimethylamine	62-75-9	9.5E-03	4.8E-01	1.3E-03	5.7E-06
N-Nitrosodiphenylamine	86-30-6	9.9E+01	5.0E+03	1.4E+01	7.6E-01
N-Nitroso di-n-propylamine	621-64-7	6.9E-02	3.5E+00	9.6E-03	4.8E-05
N-Nitroso-N-methylethylamine	10595-95-6	2.2E-02	1.1E+00	3.1E-03	2.1E-05
N-Nitrosopyrrolidine	930-55-2	2.3E-01	1.2E+01	3.2E-02	3.3E-04
m-Nitrotoluene	99-08-1	6.9E+02	6.9E+02	1.2E+02	8.0E-01
o-Nitrotoluene	88-72-2	2.8E+00	2.5E+02	2.9E-01	1.9E-03
p-Nitrotoluene	99-99-0	4.0E+01	1.8E+03	4.2E+00	2.8E-02
NuStar	85509-19-9	4.3E+01	6.2E+02	2.6E+01	1.8E+03
Oryzalin	19044-88-3	3.1E+03	4.4E+04	1.8E+03	9.6E+01
Oxadiazon	19666-30-9	3.1E+02	4.4E+03	1.8E+02	2.6E+01
Oxamyl	23135-22-0	1.5E+03	2.2E+04	2.0E+02	8.4E-01
Oxyfluorfen	42874-03-3	1.8E+02	2.6E+03	1.1E+02	2.1E+02
Paraquat	4685-14-7	2.7E+02	4.0E+03	1.6E+02	9.9E+00
Parathion	56-38-2	3.7E+02	5.3E+03	2.2E+02	1.0E+01

Voluntary Remediation Program: Table 60-3B
(Effective June 5, 2009)

CONTAMINANT	CAS No.	Residential Soil ^{1,4} (mg/kg)	Industrial Soil ^{1,4} (mg/kg)	Ground Water ^{2,4} (ug/L)	Migration to Groundwater ^{3,4} (mg/kg)
Pentachlorobenzene	608-93-5	4.9E+01	7.0E+02	2.9E+01	2.0E+01
Pentachloronitrobenzene	82-68-8	1.9E+00	9.5E+01	2.6E-01	8.3E-02
Pentachlorophenol	87-86-5	3.0E+00	1.1E+02	1.0E+00	2.8E-02
Perchlorate	7601-90-3	5.5E+01	1.4E+03	2.6E+01	
Permethrin	52645-53-1	3.1E+03	4.4E+04	1.8E+03	2.4E+03
Phenol	108-95-2	1.8E+04	2.6E+05	1.1E+04	5.6E+01
m-Phenylenediamine	108-45-2	3.7E+02	5.3E+03	2.2E+02	1.5E-00
p-Phenylenediamine	106-50-3	1.2E+04	1.7E+05	6.9E+03	4.8E+01
2-Phenylphenol	90-43-7	2.5E+02	1.3E+04	3.5E+01	1.4E+01
Phosphine	7803-51-2	1.8E+01	2.6E+02	1.1E+01	
Phosphorus (white)	7723-14-0	1.6E+00	4.1E+01	7.3E-01	5.4E-02
p-Phthalic acid	100-21-0	6.1E+04	8.8E+05	3.7E+04	2.5E+02
Phthalic anhydride	85-44-9	1.2E+05	1.0E+06	7.3E+04	5.2E+02
Polybrominated biphenyls	59536-65-1	5.5E-02	2.8E+00	7.6E-03	
Polychlorinated biphenyls (PCBs)	1336-36-3	2.2E-01	1.0E+01	5.0E-01	9.0E-01
Aroclor 1016	12674-11-2	3.9E+00	5.0E+01	9.6E-01	1.3E+00
Aroclor 1221	11104-28-2	2.2E-01	1.0E+01	5.6E-03	2.3E-03
Aroclor 1232	11141-16-5	2.2E-01	1.0E+01	5.6E-03	2.3E-03
Aroclor 1242	53469-21-9	2.2E-01	1.0E+01	3.4E-02	4.5E-02
Aroclor 1248	12672-29-6	2.2E-01	1.0E+01	3.4E-02	5.9E-02
Aroclor 1254	11097-69-1	2.2E-01	1.0E+01	3.4E-02	2.7E-01
Aroclor 1260	11096-82-5	2.2E-01	1.0E+01	3.4E-02	3.9E-01
Polynuclear aromatic hydrocarbons					
Acenaphthylene	208-96-8	3.8E+03	4.4E+04	3.7E+02	9.1E+01
Acenaphthene	83-32-9	3.7E+03	3.8E+04	3.7E+02	7.3E+01
Anthracene	120-12-7	2.2E+04	3.9E+05	1.8E+03	1.7E+03
Benz[a]anthracene	56-55-3	6.2E-01	2.9E+01	9.2E-02	1.5E+00
Benzo[b]fluoranthene	205-99-2	6.2E-01	2.9E+01	9.2E-02	4.5E+00
Benzo[k]fluoranthene	207-08-9	6.2E+00	2.9E+02	9.2E-01	4.5E+01
Benzo [g,h,i] perylene	191-24-2	1.7E+03	2.3E+04	1.1E+03	1.2E+05
Benzo [a] pyrene	50-32-8	6.2E-02	2.9E+00	2.0E-01	8.2E+00
Chrysene	218-01-9	6.2E+01	2.9E+03	9.2E+00	1.5E+02
Dibenz[ah]anthracene	53-70-3	6.2E-02	2.9E+00	9.2E-03	1.4E+00
Fluoranthene	206-44-0	2.3E+03	3.0E+04	1.5E+03	6.3E+03
Fluorene	86-73-7	2.6E+03	3.3E+04	2.4E+02	7.8E+01
Indeno[1,2,3-cd]pyrene	193-395	6.2E-01	2.9E+01	9.2E-02	1.3E+01
Naphthalene	91-20-3	5.6E+01	1.9E+02	6.2E+00	3.2E-01
Pyrene	129-00-0	2.3E+03	5.4E+04	1.8E+02	5.0E+02
Prometon	1610-18-0	9.2E+02	1.3E+04	5.5E+02	5.6E+00
Prometryn	7287-19-6	2.4E+02	3.5E+03	1.5E+02	4.6E+00
Propachlor	1918-16-7	7.9E+02	1.1E+04	4.7E+02	7.3E+00

Voluntary Remediation Program: Table 60-3B
(Effective June 5, 2009)

CONTAMINANT	CAS No.	Residential Soil ^{1,4} (mg/kg)	Industrial Soil ^{1,4} (mg/kg)	Ground Water ^{2,4} (ug/L)	Migration to Groundwater ^{3,4} (mg/kg)
Propanil	709-98-8	3.1E+02	4.4E+03	1.8E+02	2.2E+00
Propargite	2312-35-8	1.2E+03	1.8E+04	7.3E+02	4.0E+03
iso-Propylbenzene (Cumene)	98-82-8	1.6E+02	2.9E+02	6.6E+02	6.3E+01
n-Propylbenzene	103-65-1	7.8E+02	2.0E+04	3.7E+02	4.3E+01
Propylene glycol	57-55-6	3.0E+04	4.1E+05	1.8E+04	7.4E+01
Propylene glycol, monoethyl ether	111-35-3	4.3E+04	6.2E+05	2.6E+04	1.0E+02
Propylene glycol, monomethyl ether	107-98-2	4.3E+04	6.2E+05	2.6E+04	1.0E+02
Pursuit	81335-77-5	1.5E+04	2.2E+05	9.1E+03	5.4E+02
Pyridine	110-86-1	6.1E+01	8.8E+02	3.7E+01	1.9E-01
Quinoline	91-22-5	1.5E-01	2.2E+00	2.2E-02	1.7E-03
RDX (Cyclonite)	121-82-4	4.4E+00	2.2E+02	6.1E-01	7.2E-03
Resmethrin	10453-86-8	1.8E+03	2.6E+04	1.1E+03	1.9E+04
Ronnel	299-84-3	3.1E+03	4.4E+04	1.8E+03	1.5E+02
Rotenone	83-79-4	2.4E+02	3.5E+03	1.5E+02	2.0E+03
Selenious Acid	7783-00-8	3.1E+02	4.4E+03	1.8E+02	
Selenium	7782-49-2	3.9E+02	1.0E+04	5.0E+01	5.2E+00
Silver and compounds	7440-22-4	3.9E+02	1.0E+04	1.8E+02	3.1E+01
Simazine	122-34-9	4.0E+00	2.1E+02	4.0E+00	2.4E-02
Sodium azide	26628-22-8	3.1E+02	8.2E+03	1.5E+02	
Sodium diethyldithiocarbamate	148-18-5	1.8E+00	9.1E+01	2.5E-01	1.3E-03
Strontium, stable	7440-24-6	4.7E+04	1.0E+06	2.2E+04	1.5E+04
Strychnine	57-24-9	1.8E+01	2.6E+02	1.1E+01	1.7E-01
Styrene	100-42-5	6.3E+02	6.3E+02	1.0E+02	4.1E+00
2,3,7,8-Tetrachlorodibenzodioxin (TCDD/dioxin)	1746-01-6	3.9E-06	2.7E-04	5.0E-06	9.6E-05
1,2,4,5-Tetrachlorobenzene	95-94-3	1.8E+01	2.6E+02	1.1E+01	6.6E-01
1,1,1,2-Tetrachloroethane	630-20-6	3.0E+00	7.1E+01	4.3E-01	3.1E-03
1,1,2,2-Tetrachloroethane	79-34-5	3.8E-01	9.0E+00	5.5E-02	4.0E-04
Tetrachloroethylene (PCE)	127-18-4	5.6E-01	1.9E+01	5.0E+00	8.0E-02
2,3,4,6-Tetrachlorophenol	58-90-2	1.8E+03	2.6E+04	1.1E+03	9.2E+01
p,a,a,a-Tetrachlorotoluene	5216-25-1	2.4E-02	1.2E+00	3.4E-03	2.7E-04
Tetrahydrofuran	109-99-9	9.3E+00	2.2E+02	1.6E+00	6.7E-03
Thallium and compounds	7446-18-6	6.3E+00	1.6E+02	2.0E+00	2.8E+00
Thiobencarb	28249-77-6	6.1E+02	8.8E+03	3.7E+02	4.1E+01
Thiocyanate	463-56-9	1.2E+01	1.8E+02	7.3E+00	3.4E-02
Tin and compounds	7440-31-5	4.7E+04	1.0E+06	2.2E+04	1.1E+05
Toluene	108-88-3	2.6E+02	2.6E+02	1.0E+03	1.0E+01
Toluene-2,4-diamine	95-80-7	1.5E-01	7.7E+00	2.1E-02	1.8E-04
Toluene-2,5-diamine	95-70-5	3.7E+04	5.3E+05	2.2E+04	1.9E+02
Toluene-2,6-diamine	823-40-5	1.8E+03	2.6E+04	1.1E+03	9.7E+00
p-Toluidine	106-49-0	2.6E+00	1.3E+02	3.5E-01	5.9E-03
Toxaphene	8001-35-2	4.4E-01	2.2E+01	3.0E+00	3.1E+01
1,2,4-Tribromobenzene	615-54-3	3.1E+02	4.4E+03	1.8E+02	6.0E+00

Voluntary Remediation Program: Table 60-3B
(Effective June 5, 2009)

CONTAMINANT	CAS No.	Residential Soil ^{1,4} (mg/kg)	Industrial Soil ^{1,4} (mg/kg)	Ground Water ^{2,4} (ug/L)	Migration to Groundwater ^{3,4} (mg/kg)
Tributyltin oxide (TBTO)	56-35-9	1.8E+01	2.6E+02	1.1E+01	1.6E+04
2,4,6-Trichloroaniline	634-93-5	1.4E+01	7.3E+02	2.0E+00	2.4E-02
1,2,4-Trichlorobenzene	120-82-1	7.8E+02	2.0E+04	7.0E+01	4.9E+00
1,1,1-Trichloroethane	71-55-6	7.1E+02	7.1E+02	2.0E+02	2.1E+00
1,1,2-Trichloroethane	79-00-5	8.4E-01	1.9E+01	5.0E+00	3.5E-02
Trichloroethylene (TCE)	79-01-6	4.3E-02	9.2E-01	5.0E+00	4.3E-02
Trichlorofluoromethane	75-69-4	3.9E+02	9.5E+02	1.3E+03	2.2E+01
2,4,5-Trichlorophenol	95-95-4	6.1E+03	8.8E+04	3.7E+03	2.5E+02
2,4,6-Trichlorophenol	88-06-2	4.4E+01	2.2E+03	6.1E+00	1.2E-01
2,4,5-Trichlorophenoxyacetic Acid	93-76-5	6.1E+02	8.8E+03	3.7E+02	2.0E+00
2-(2,4,5-Trichlorophenoxy) propionic acid	93-72-1	4.9E+02	7.0E+03	5.0E+01	3.6E+00
1,1,2-Trichloropropane	598-77-6	1.5E+01	5.1E+01	3.0E+01	2.5E-01
1,2,3-Trichloropropane	96-18-4	3.2E-01	1.1E+01	3.4E-02	2.7E-04
1,2,3-Trichloropropene	96-19-5	7.1E-01	2.3E+00	2.2E+00	1.7E-02
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	2.6E+03	2.6E+03	5.9E+04	2.8E+03
1,2,4-Trimethylbenzene	95-63-6	5.2E+01	1.7E+02	1.2E+01	1.9E+00
1,3,5-Trimethylbenzene	108-67-8	2.1E+01	7.0E+01	1.2E+01	4.6E-01
Trimethyl phosphate	512-56-1	1.3E+01	6.7E+02	1.8E+00	7.8E-03
1,3,5-Trinitrobenzene	99-35-4	1.8E+03	2.6E+04	1.1E+03	5.2E+01
Trinitrophenylmethylnitramine (Tetryl)	479-45-8	2.4E+02	3.5E+03	1.5E+02	1.3E+01
2,4,6-Trinitrotoluene	118-96-7	1.6E+01	4.4E+02	2.2E+00	1.7E-01
Uranium (chemical toxicity only)	7440-61-0	1.6E+01	4.1E+02	7.3E+00	
Vanadium and compounds	7440-62-2	7.8E+01	2.0E+03	3.7E+01	7.3E+02
Vinclozolin	50471-44-8	1.5E+03	2.2E+04	9.1E+02	1.4E+01
Vinyl acetate	108-05-4	4.3E+02	1.4E+03	4.1E+02	1.8E+00
Vinyl bromide	593-60-2	1.9E-01	4.2E+00	1.0E-01	9.5E-04
Vinyl chloride (lifetime)	75-01-4	1.5E-01		2.0E+00	1.3E-02
Vinyl chloride (adult)	75-01-4		8.8E+00	2.0E+00	1.3E-02
Warfarin	81-81-2	1.8E+01	2.6E+02	1.1E+01	4.4E-01
Xylenes	1330-20-7	1.0E+02	1.0E+02	1.0E+04	1.2E+02
Zinc	7440-66-6	2.3E+04	6.1E+05	1.1E+04	1.4E+04
Zinc phosphide	1314-84-7	2.3E+01	6.1E+02	1.1E+01	
Zineb	12122-67-7	3.1E+03	4.4E+04	1.8E+03	8.0E+00

1 - The residential and industrial soil values consider ingestion and dermal exposure to soil and inhalation exposure to contaminants moving from soil to ambient air.

2- Risk-based groundwater values consider ingestion and inhalation exposure arising from the domestic use of groundwater. Where the groundwater standard at 46CSR12 is greater than the risk-based concentration, the groundwater standard is listed instead of the risk-based concentration.

3 - The migration from soil to groundwater values shall be applied unless it is shown to the satisfaction of the Secretary that migration of soil contaminants to groundwater will not result in an exceedance of the DeMinimis Groundwater Standards.

4 - The concentrations in this table shall be applied where the exposure pathways described in footnotes 1,2, and 3 are the major contributors to risks identified in the site assessment. If other exposure pathways are identified, the acceptable concentrations shall be determined only in consultation with the Secretary, considering all exposure pathways, and all other requirements of the regulations.

(*) Lead - Residential soil based on Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (July 1994), USEPA OSWER Directive 9355.4-12. Industrial soil based on the USEPA documents Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soils (December 1996) and Frequently Asked Questions (FAQs) on the Adult Lead Model (April 1999).

DRAFT SUPPLEMENTAL GUIDANCE ON TPH

Draft De Minimis Levels in Soil and Groundwater for Total Petroleum Hydrocarbons (TPH)				
Contaminant	Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Groundwater (ug/l)	Migration to Groundwater from Soil (mg/kg)
TPH GRO	1,900	6,600	1,500	83
TPH DRO	4,100	8,300*	810	170
TPG ORO	6,100	9,000*	3,700	9,000*
<p>GRO – Gasoline Range Organics (C₆-C₁₀) DRO – Diesel Range Organics (C₁₀-C₂₅) ORO – Oil Range Organics (C₂₅-C₃₅) * Values based on residual soil saturation Note: De Minimis levels for TPH do not replace those for BTEX and PAHs; De Minimis levels for BTEX and PAH also apply. No free product or surface staining is permitted, regardless of TPH Values.</p>				

APPENDIX B

Standard Operating Procedures (SOPs)

GENERAL DECONTAMINATION PROCEDURES
FOR NON-DISPOSABLE FIELD
SAMPLING EQUIPMENT
SOP OER-0100

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration-Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	1.0	07/1/10	Reformatted, added SOP ID # and renumbered, supersedes Revision 0.0. Additional detail provided for decontamination procedures.	Editorial Technical

GENERAL DECONTAMINATION PROCEDURES
FOR NON-DISPOSABLE FIELD
SAMPLING EQUIPMENT
SOP OER-0100

Table of Contents

<u>Title</u>	<u>Page</u>
1.0 Scope and Application	3
2.0 Summary of Method	3
3.0 Sample Preservation, Containers, Handling, and Storage	3
4.0 Interferences and Potential Problems	4
5.0 Equipment/Apparatus	4
6.0 Reagents	4
7.0 Procedures	5
7.1 Decontamination Methods	5
7.1.1 Abrasive Cleaning Methods	5
7.1.2 Non-Abrasive Cleaning Methods	6
7.1.3 Disinfection/Rinse/Hand Removal Methods	6
7.2 Field Sampling Equipment Cleaning Procedures	6
8.0 Calculations	7
9.0 Quality Assurance/Quality Control	7
10.0 Data Validation	7
11.0 Health and Safety	7
12.0 References	8

GENERAL DECONTAMINATION PROCEDURES
FOR NON-DISPOSABLE FIELD
SAMPLING EQUIPMENT
SOP OER-0100

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide a description of the methods used for preventing, minimizing, or limiting cross-contamination of samples due to inappropriate or inadequate equipment decontamination and to provide general guidelines for developing decontamination procedures for sampling equipment to be used for OER projects. This SOP does not address personnel decontamination.

These are standard (i.e. typically applicable) operating procedures which may be varied or changed as needed, dependent upon site conditions, equipment limitation, and/or limitations imposed by the procedure. The actual procedures employed at a site should be fully documented.

2.0 SUMMARY OF METHOD

Removing contaminants from equipment minimizes the likelihood of sample cross contamination and reduces or eliminates transfer of contaminants to clean areas. All non-disposable sampling equipment (including, but not limited to: trowels, spatulas, hand augers, shovels, stainless steel mixing bowls, split spoon sampler, GeoProbeTM sampling spoon, etc.) will be thoroughly cleaned. Decontamination of all of the sampling equipment will be accomplished prior to and between sampling locations. The decontamination procedure may be briefly summarized as follows:

- Physical removal of gross contamination.
- Non-phosphate detergent wash.
- Tap water rinse.
- Distilled/deionized water rinse.
- 10% nitric acid rinse (applicable only when analyzing for low level trace metals).
- Distilled/deionized water rinse.
- Solvent rinse (applicable only when analyzing for low-level trace organics).
- Let equipment air dry.
- Distilled/deionized water rinse.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Sample collection and analysis of decontamination waste may be required before beginning proper disposal of decontamination liquids and solids generated at a site. The amount of sample

to be collected and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements should be determined prior to initiation of site activities. As part of the development of the project specific Sampling and Analysis Plan (SAP), decontamination waste sampling procedures should be determined and then incorporated into the SAP. Parameters to be sampled will be dependent upon the matrix being sampled and the requirements of the disposal facility.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The use of an untreated potable water supply is not an acceptable substitute for tap water. The use of distilled/deionized water commonly available from commercial vendors should generally be acceptable for decontamination of sampling equipment. If there is a concern that the water is not analyte free, then it can be verified by laboratory analysis. If acids or solvents are utilized in decontamination they raise health and safety as well as waste disposal concerns. Care must be used when working with acids and organic solvents.

5.0 EQUIPMENT/APPARATUS

Decontamination equipment, materials, and supplies are generally selected based on availability. Other considerations include the ease of decontaminating or disposing of the equipment. The following are some of the materials and equipment that are potentially needed for decontamination activities:

- Non-phosphate detergent.
- Organic and inorganic decontamination reagents, if required by site-specific SAP.
- Tap water.
- Distilled or deionized water.
- Brushes (various assortment of sizes).
- Drop cloth/plastic sheeting.
- Paper towels.
- Wash and rinse containers (buckets).
- Pressurized sprayers.
- Solvent sprayers.
- Trowel.
- Trash bags.
- Trash containers.
- DOT approved 55-gallon drums.
- Safety glasses.
- Gloves.
- Eyewash.
- First Aid kit.

6.0 REAGENTS

Depending upon the project, a solvent rinse using organic or inorganic desorbing agent may be required. This shall be specified in the site-specific SAP. In cases where the use of solvents is planned, the analytical laboratory performing the analysis shall be consulted prior to sampling to ensure that decontamination procedures do not affect the subsequent analysis. It is recommended that all solvent rinses be made from an appropriate grade of chemical, such as pesticide or purge-and-trap grade quality.

7.0 PROCEDURES

These procedures are intended as general procedures to be followed for decontamination of field sampling equipment. The site-specific SAP should be referred to for any given project in order to establish what portions of these procedures are applicable to the project. It is always recommended that procedures be established in the site-specific SAP to minimize the potential for contamination. Such procedures may include the following:

- Work practices that minimize contact with potential contaminants.
- Covering monitoring and sampling equipment with plastic or other protective material.
- Avoiding laying down equipment in areas of obvious contamination.
- Use of disposable sampling equipment.

7.1 Decontamination Methods

Various decontamination methods will physically remove contaminants; inactivate contaminants by disinfection or sterilization, or do both. In many cases, gross contamination can be removed by physical means. The physical decontamination techniques appropriate for equipment decontamination can be grouped into two categories: abrasive methods and non-abrasive methods.

7.1.1 Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. The following abrasive methods are available:

- Mechanical cleaning methods are brushes of metal or nylon. The amount and type of contaminants removed will vary with the hardness of bristles, length of brushing time, and degree of brush contact.
- Air blasting is used for cleaning large equipment, such as bulldozers, drilling rigs or auger bits. The equipment used in air blast cleaning employs compressed air to force abrasive material through a nozzle at high velocities. The distance between the nozzle and the surface cleaned, as well as the pressure of air, the time of application, and the angle at which the abrasive strikes the surface, determines cleaning efficiency. This method generates a large amount of waste and is unlikely to be utilized on OER projects.

- Wet blast cleaning, also used to clean large equipment, involves use of a suspended fine abrasive delivered by compressed air to the contaminated area. The amount of materials removed can be carefully controlled by using very fine abrasives. This method generates a large amount of waste and is unlikely to be utilized on OER projects.

7.1.2 Non-Abrasive Cleaning Methods

Non-abrasive cleaning methods work by forcing the contaminant off of a surface with pressure. The following non-abrasive methods are available:

- High-Pressure Water: This method consists of a high-pressure pump, an operator controlled directional nozzle, and a high pressure hose.
- Low Pressure Water: This system produces a pressurized water jet with operating pressures less than 240 atm which relates to a flow rate less than 20 liters per minute. Because of the low pressure, this method is applicable for hand-held sampling equipment.

7.1.3 Disinfection/Rinse/Hand Removal Methods

- Disinfection/Sterilization: Disinfectants are a practical means of inactivating infectious agents and sterilization methods involve heating the equipment which is impractical for large equipment. It is unlikely that these methods would be utilized on OER projects.
- Rinsing: In cases of gross soil/sediment contamination on hand held sampling equipment, a tap water rinse/wash may first be performed to remove clumps of dirt in order to make the detergent wash more effective.
- Hand Removal: In cases of gross soil/sediment contamination on hand held sampling equipment, dirt may be removed by hand (gloved) or using a trowel or similar device to remove clumps of dirt in order to make the detergent wash more effective.

7.2 Field Sampling Equipment Cleaning Procedures

If trace analysis for organics or metals is to be performed then a solvent rinse for trace organics and an acid rinse for trace metals would be appropriate. If no trace analysis is planned, the solvent and acid rinses may be eliminated from the decontamination sequence specified below.

1. In cases of gross contamination, follow the most appropriate physical removal procedures specified in section 7.1.
2. Using a brush, wash equipment with soap (non-phosphate) and water.
3. Rinse the equipment with tap water. If contaminants are clearly present, wash the equipment again and rinse again with tap water.

4. Rinse with distilled/deionized water. A triple rinse with distilled/deionized water is recommended. (If solvent or acid rinses are not necessary, then proceed to step 9.)
5. If applicable, rinse with 10% nitric acid if the samples will be analyzed for trace level metals.
6. Rinse with distilled/deionized water.
7. Use a solvent rinse, as appropriate, if the sample will be analyzed for trace level organics.
8. Rinse with distilled/deionized water
9. Decontaminated equipment shall be dried or allowed to air dry on plastic sheeting in an area free of potential contaminants.
10. Store decontaminated equipment in an area free of potential contaminants when it is not in use.

8.0 CALCULATIONS

There are no calculations associated with decontamination procedures. This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

Decontamination of field sampling equipment is necessary when dedicated or non-disposable sampling equipment is not utilized at a site. An equipment rinsate blank should be collected as part of the quality control associated with the field decontamination on non-disposable, non-dedicated sampling equipment. This sample will provide information on the effectiveness of the decontamination process in the field. Equipment rinsate blanks are samples obtained by running distilled or deionized water over the decontaminated sampling equipment after cleaning to test for residual contamination. The equipment rinsate water is collected in sample containers and handled exactly as any other samples from the site. One equipment rinsate blank should be collected per each day of field work. An equipment rinsate blank is used to assess cross contamination brought about by improper decontamination procedures.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or Quality Assurance Project Plan (QAPP) shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans.

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Sampling Equipment Decontamination, SOP# 2006, US EPA, Environmental Response Team, August 11, 1994

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005

PID FIELD SCREENING
SOP OER-0101

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration-Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	0.0	08/2/10	New SOP	Technical

PID FIELD SCREENING

SOP OER-0101

Table of Contents

<u>Title</u>	<u>Page</u>
1.0 Scope and Application	3
2.0 Summary of Method	3
3.0 Sample Preservation, Containers, Handling, and Storage	3
4.0 Interferences and Potential Problems	3
5.0 Equipment/Apparatus	4
6.0 Reagents	4
7.0 Procedures	4
8.0 Calculations	5
9.0 Quality Assurance/Quality Control	6
10.0 Data Validation	6
11.0 Health and Safety	6
12.0 References	6

PID FIELD SCREENING

SOP OER-0101

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to describe the procedure for using a photoionization detector (PID). The PID is a portable vapor/gas detector employing the principle of photoionization to detect a variety of chemical compounds. It is of particular use in identifying organic compounds, but can identify certain inorganic compounds such as chlorine, bromine, silicon, and sulfur. This procedure is a non-specific method applicable to field screening for organic compounds in surface and subsurface soils.

2.0 SUMMARY OF METHOD

The PID is a useful field screening tool. A PID is capable of detecting and measuring real-time concentrations of many organic vapors and some inorganic vapors. The PID is unable to respond to certain low molecular weight hydrocarbons, such as methane and ethane. The PID works by employing the principle of photoionization. It will respond to most vapors that have an ionization potential less than or equal to that supplied by the ionization source. The ionization source is an ultraviolet (UV) lamp.

Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and form a positive ion. This will occur when the ionization potential of the molecule in electron volts (eV) is less than the energy of the photon. Several ionization sources are available for the PID, each having a different eV lamp and a different ionization potential. The selection of the appropriate ionization source is essential in obtaining useful data. Though it can be calibrated to a particular compound, the instrument cannot distinguish between detectable compounds in a mixture of gases. Therefore, the PID can only indicate an integrated response to the mixture.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The PID is a nonspecific total vapor detector; therefore it cannot be used to identify unknown substances. The PID does not respond to certain low molecular weight hydrocarbons, such as methane and ethane. The PID does not detect a compound if the probe has a lower energy than the compound's ionization potential. Certain toxic gases and vapors, such as carbon tetrachloride

and hydrogen cyanide, have high ionization potentials and cannot be detected with a PID. Strong winds and high humidity will affect measurement readings. A PID may become unusable under foggy or humid conditions. The lamp window must be periodically cleaned to ensure ionization of the compounds by the probe. Pulling liquids into the probe will result in poor readings and can damage the instrument.

5.0 EQUIPMENT/APPARATUS

The following are some of the materials and equipment that are potentially needed for soil screening activities using the PID. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- PID.
- Calibration equipment and gases (isobutylene).
- Plastic bags.
- Field logbook, field data sheets and samples labels.
- Chain of custody records and seals.
- Sample and shipping containers.
- Preservatives, as applicable.
- Pails, tubs, or buckets.
- Plastic sheeting.
- Packing materials.
- Sampling gloves.
- Methanol.
- Light source cleaning compound.
- Mild, non-phosphate soap.

6.0 REAGENTS

The following reagents may be needed when using a PID for field screening purposes:

- Isobutylene standards for calibration.
- Methanol for cleaning ionization chamber (GC grade).
- Mild soap solution for cleaning unit surfaces.
- Specific gas standards when calibrating to a specific compound (as applicable).
- Light source cleaning compound.

7.0 PROCEDURES

The following procedures are applicable for field screening of organic compounds utilizing a PID:

1. Calibrate the instrument daily in accordance with manufacturer specifications before any headspace readings are performed. Re-calibrate the instrument throughout the day as needed.
2. Place the portion of soil sample to be screened inside a clean plastic bag and then seal the bag. Fill the bag at least 1/3 the way full (no more than 1/2 full) if sufficient sample is available.
3. Knead the soil in the bag in order to homogenize it.
4. Allow the bag to set for at least fifteen minutes prior to taking a reading. *Note: If the ambient temperature is below 60 degrees Fahrenheit, headspace analysis shall be conducted in a heated environment (i.e., inside a building or vehicle).*
5. Place the probe tip of the PID in through the top 1/3 of the bag. The zipper lock bag shall not be reopened for the insertion of the probe tip. *Note: Care shall be taken to ensure that neither water droplets nor soil particulates enter the probe tip.*
6. The highest meter response shall be recorded as the volatile organic vapor concentration.
7. All headspace analysis shall be completed at an equivalent time period between 15 minutes to an hour.
8. Record the PID readings in the field logbook along with other sampling information such as:
 - Sample ID.
 - Location.
 - Depth of sample.
 - Soil type description.
 - Equipment used.
 - Apparent moisture content (i.e., dry, moist, wet).
 - Color.
 - Odor.
 - Any Other Pertinent Information.

Note: Soil samples collected for field soil screening may not be used for laboratory analysis. Separate soil samples must be collected according to the soil sampling protocols outlined in the site-specific Sampling and Analysis Plan.

8.0 CALCULATIONS

No calculations are applicable to this SOP. The PID is a direct reading instrument.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance activities which apply to these procedures. However, the following general QA procedures do apply:

- All data must be documented on field data sheets and/or in field logbooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan.
- Equipment calibration activities must be documented and must occur prior to beginning sampling operations. Performance checks on the PID should be performed throughout the course of a day, and recalibration of the instrument should be performed as needed.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans.

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA,
Office of Environmental Information, April 2007

Photoionization Detector, *SOP# 2114*, US EPA, Environmental Response Team, October 1994

XRF FIELD SCREENING
SOP OER-0102

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration-Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	0.0	08/3/10	New SOP	Technical

XRF FIELD SCREENING

SOP OER-0102

Table of Contents

<u>Title</u>	<u>Page</u>
1.0 Scope and Application	3
2.0 Summary of Method	3
3.0 Sample Preservation, Containers, Handling, and Storage	3
4.0 Interferences and Potential Problems	3
4.1 Sample Placement	4
4.2 Representative Nature of Samples	4
4.3 Chemical Matrix Effects	4
4.4 Physical Matrix Effects	4
4.5 Moisture Content	4
5.0 Equipment/Apparatus	4
6.0 Reagents	5
7.0 Procedures	5
7.1 General Procedures	5
7.2 In-Situ Analysis	6
7.3 Bagged Soil Sample Testing	7
8.0 Calculations	7
9.0 Quality Assurance/Quality Control	8
10.0 Data Validation	8
11.0 Health and Safety	8
12.0 References	9

XRF FIELD SCREENING

SOP OER-0102

1.0 SCOPE AND APPLICATION

This procedure is applicable to field screening of a variety of metals in surface and subsurface soils. This is a field screening method used for profiling an area, locating sources of contamination, determining the horizontal and vertical extent of contamination, and/or collecting preliminary data that may be used to design a sampling plan.

X-Ray Fluorescence Spectroscopy (XRF) is a nondestructive qualitative and quantitative analytical technique used to determine the chemical composition of samples. Primary X-rays are emitted from a sealed radioisotope source and are utilized to irradiate samples. In the samples, radiation knocks out an electron from the innermost shell of an atom. The atom is excited and releases its surplus energy almost instantly by filling the vacancy created with an electron from one of the higher energy shells. This rearrangement of electrons is associated with emission of X-rays characteristic of the given atom and represents an emission of fluorescent X-rays. Energies of the characteristic, fluorescent X-rays are converted within the detector into electric pulses, the amplitudes of which are linearly proportional to the energy. An electronic analyzer measures the pulse amplitudes which are the basis of a qualitative X-ray analysis. The number of equivalent counts at a given energy is representative of element concentration in a sample basis for quantitative analysis.

2.0 SUMMARY OF METHOD

Testing of samples may be done in-situ, in plastic bags with minimal preparation, or in plastic bags or the XRF cup with more extensive sample preparation. If the primary objective of the sampling event is to determine whether an element is present then in-situ or bagged samples with little preparation would be the quickest simplest way to proceed. If measuring accuracy of the concentration of metal present is the primary objective, then additional preparation of the sample is recommended. Precision and accuracy between samples is best achieved with prepared homogenous samples.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Generally, the instrument precision is the least significant source of error in XRF analysis. User or application related error is most often the most significant source of error. Following are some of the components of user or application related errors.

4.1 Sample Placement

This is a potential source of error since the X-ray signal decreases as you increase the distance from the radioactive source. This type of error can be minimized by maintaining the same sample distance from the source. This SOP allows for the use of a thin plastic wrap (like Saran Wrap) that can be placed between the soil and the analyzer window to keep the window clean. This has little, if any, effect on the distance from the sample to the radioactive source; therefore, it does not cause a potential source of error due sample placement issues. However, for a few elements (namely Chromium, Vanadium, and Barium) testing through thin plastic may result in lower readings (~ 20%) for these elements.

4.2 Representative Nature of Samples

Heterogeneous samples can be a major source of error. This error can be minimized by either homogenizing a large volume of sample prior to analyzing an aliquot, or by analyzing several samples (in-situ) at each sampling point and then averaging the results.

4.3 Chemical Matrix Effects

Chemical matrix effects result from differences in concentrations of interfering elements. These effects appear as either spectral interferences (peak overlaps) or as X-ray absorption/enhancement phenomena. Both effects are common in soils contaminated with heavy metals. For example, Fe (iron) tends to absorb Cu (copper), reducing the intensity of Cu measured by the detector.

4.4 Physical Matrix Effects

Physical matrix effects are the result of variations in the physical character of the sample. They may include such parameters as particle size, uniformity, homogeneity and surface condition.

4.5 Moisture Content

The overall error from moisture may be a minor source of error when the moisture range is small (5-20%), or may be a major source of error when measuring on the surface of soils that are saturated with water.

5.0 EQUIPMENT/APPARATUS

The following are some of the materials and equipment that are potentially needed for soil screening activities using the XRF. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- XRF.
- Batteries and chargers.
- Standardization clip.
- Sieves.
- Plastic bags.
- Mortar and pestle.
- Sample test stand, if desired.
- Logbook.
- Field data sheets and samples labels.
- Chain of custody records and seals.
- Sample and shipping containers.
- Preservatives, as applicable.
- Pails, tubs, or buckets.
- Plastic sheeting.
- Packing materials.
- Sampling gloves.

6.0 REAGENTS

Standardization of the XRF is performed utilizing the metal standardization clip; therefore, reagents are not generally used for site screening using the XRF. Reagents associated with decontamination of sampling equipment may be applicable if samples are not analyzed “in-situ”. Refer to SOP OER-0100 for general decontamination procedures for non-disposable sampling equipment.

7.0 PROCEDURES

7.1 General Procedures

1. Install a fully charged battery in the instrument and verify that the iPAQ is correctly seated on the top of the unit. If the iPAQ is properly connected, the amber light on the upper right side of the iPAQ will blink.
2. Turn both the XRF (back of the unit) and the iPAQ (top right hand side) on. If the iPAQ fails to turn on, it may be necessary to perform a “soft reset”. *(Note: Remove the iPAQ from the unit, insert the tip of the stylus into the small hole on the bottom left hand side of the iPAQ to perform a “soft reset”. Re-seat the iPAQ back into the instrument.)*

3. Start the Innov-X Systems software by selecting the Start Menu from the upper right handcorner of the iPAQ screen. Select the Innov-X software from the drop down menu. *(Note: The red light on the end of the instrument will be on when it is on and ready for use. It will flash when the trigger is pulled indicating that the instrument is emitting radiation.)*
4. Select Start and the Main Menu will open.
5. Choose the test mode (Soil) from the menu. *(Note: It will take a minute or two for the instrument to go through a hardware initiation phase.)*
6. The instrument will prompt you to perform a standardization test. The instrument will not operate until a successful standardization test has been performed. Place the standardization clip securely over the sample window of the XRF and tap the message box to initiate standardization which will take about 1 minute.
7. When standardization is complete, the resolution of the analyzer will be displayed. Tap OK to acknowledge and clear the screen.
8. If you wish to enter a sample name or sample id, select EDIT→ Test Info. Enter information in text fields, or select items from drop down menus. In the soil mode there are preset options such as Operator, Sample Method, Sample Number, Sample Depth and comments. These can be customized as necessary. Fill in the information for the sample prior to analysis. The analysis will be stored with this information. You will need to enter new sample information prior to each sample run. Select OK to close the test information window.
9. The analyzer is now ready to take measurements.

7.2 In-Situ Analysis

These procedures are applicable for analysis of surface soils and can be used for vertical profiling of acetate sleeves retrieved by direct push technology.

1. Complete the procedures outlined in the General Procedures Section.
2. Clear the area selected for analysis of any surface debris or vegetation. Level the area so the XRF sample window will contact the area evenly. If desired, a thin plastic wrap (like Saran Wrap) can be placed between the soil and the analyzer window to keep the window clean. *(Note: Except for a few elements (namely Chromium, Vanadium, and Barium) testing through the thin plastic has little effect on the test results. Results for chromium, vanadium, and barium may be lower by 20 to 30%.)*

3. Hold the XRF to the sample. Make sure the sample is as flush against the analyzing window as is possible. To start the test, pull and hold the trigger. Releasing the trigger prematurely will abort the analysis. *(Note: The software lock may have to be disabled if the instrument has not been used for more than 5 minutes.)* After analysis is started, the message, “TEST IN PROGRESS” will appear with a timer. For the duration of the test, the red light on the XRF will blink and the “testing” icon will appear in the lower right hand corner of the iPAQ. The results will be displayed on the screen after a short time.
4. Once the result screen opens, you can enter new sample information for the next sample as outlined in the General Procedures and then press the trigger to analyze the next sample. To exit the analysis screen, select FILE→ EXIT or tap the X in the upper right hand corner of the screen.

7.3 Bagged Soil Sample Testing

1. A soil sample is collected in a thin plastic bag (i.e. a “baggie”). It is recommended that at least 100 grams of soil are placed in the baggie. When shooting the soil, a thickness of at least 0.5 inches of soil in the bag is recommended.
2. When placing soil in the baggie, remove vegetation, debris, and rocks from the soil to the extent practical. Mix the soil in the baggie to homogenize it. If greater accuracy is desired, dry soil may be passed through a 10 um sieve to better homogenize it. A mortar and pestle may be used to break the soil into smaller particles to ease its passage through the sieve. If wet soil is encountered, using a sieve is not an option in the field unless a method to dry the soil can be found.
3. Hold the XRF to the sample. Make sure the sample is as flush against the analyzing window as is possible. To start the test, pull and hold the trigger. Releasing the trigger prematurely will abort the analysis. *(Note: The software lock may have to be disabled if the instrument has not been used for more than 5 minutes.)* After analysis is started, the message, “TEST IN PROGRESS” will appear with a timer. For the duration of the test, the red light on the XRF will blink and the “testing” icon will appear in the lower right hand corner of the iPAQ. The results will be displayed on the screen after a short time.
4. Once the result screen opens, you can enter new sample information for the next sample as outlined in the General Procedures and then press the trigger to analyze the next sample. To exit the analysis screen, select FILE→ EXIT or tap the X in the upper right hand corner of the screen.

8.0 CALCULATIONS

No calculations are applicable to this SOP. The XRF is a direct reading instrument.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The analysis of soils by XRF should be considered as a screening tool. Data derived from the instrument should be used with discretion. The following general QA procedures apply:

- All data must be documented on field data sheets, in field logbooks, and/or downloaded to a computer.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan.
- Equipment calibration activities must be documented and must occur prior to beginning sampling operations. Performance checks on the XRF should be performed throughout the course of a day, and re-standardization of the instrument should be performed as needed.
- Confirmation samples should be collected at a minimum rate of 10% and sent to a laboratory for analysis. In order to properly perform a comparative analysis of the field screening method with the lab data, it is important to send the soil to the lab that was actually field screened due to the potential problems noted in Section 4.0 of this SOP.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

Confirmation samples are recommended at a minimum rate of 10%. Ideally, the sample that was analyzed by XRF should be the same sample that is sent for laboratory analysis. When confirming an in-situ analysis, collect a sample from a six-inch by six-inch area for both an XRF measurement and confirmation analysis.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered to when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a

summary of just some of the hazards associated with soil sampling and the use of the XRF for environmental analysis:

- Exposure to unknown contaminants.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slip, trip, and falls.
- The XRF has a radiation source. The XRF should not be pointed at anyone or any body part, whether energized or de-energized.
- Except as explained in the Innov-X Manual, do not service the XRF. Failure to heed this warning could result in exposure to radiation or electrical shock.
- Ensure that the proper batteries are placed in the instrument. There is a danger of explosion if improper substitution of batteries is made.
- Do not disengage the “deadman” trigger unless the instrument is set up in the sampling table. When using the XRF in the “hand held” mode it is important that the “deadman” trigger be engaged in order to ensure that the analyzer is attended at all times while x-rays are being emitted.

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Innov-X Alpha Series XRF User Manual, Innov-X Systems Inc., August 2005

"Field-Portable X-Ray Fluorescence", U.S. EPA/ERT Quality Assurance Technical Information Bulletin, Vol. 1, No. 4, May 1991.

XRAY Fluorescence Operating Procedures, SOP# 1707, US EPA, Environmental Response Team, December 22, 1994

GROUNDWATER WELL SAMPLING PROCEDURES
SOP OER-0110

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration-Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	1.0	07/1/10	Reformatted, added SOP ID # and renumbered, supersedes Revision 0.0	Editorial
			Additional detail provided	Technical

GROUNDWATER WELL SAMPLING PROCEDURES

SOP OER-0110

Table of Contents

<u>Title</u>	<u>Page</u>
1.0 Scope and Application	3
2.0 Summary of Method	3
3.0 Sample Preservation, Containers, Handling, and Storage	3
4.0 Interferences and Potential Problems	4
4.1 General	4
4.2 Purging	4
5.0 Equipment/Apparatus	4
6.0 Reagents	5
7.0 Procedures	5
7.1 General Procedures	5
7.2 Bailer Method	6
7.3 Submersible Pump (Low Flow Method)	7
8.0 Calculations	9
9.0 Quality Assurance/Quality Control	10
10.0 Data Validation	10
11.0 Health and Safety	10
12.0 References	11

GROUNDWATER WELL SAMPLING PROCEDURES

SOP OER-0110

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide general reference information on sampling of groundwater wells. Groundwater samples give an indication of the nature and extent of any groundwater contamination, and provide data on groundwater quality. Groundwater sampling procedures can be split into two tasks, purging and sampling. Purging is the process of removing stagnant water from the monitoring well prior to sampling and replacing it with groundwater from the adjacent formation. This ensures that a more representative sample of the actual aquifer condition is collected. Every effort must be made to ensure that the sample is representative of the particular zone of water being sampled. These procedures are designed to be used in conjunction with analyses for the most common types of ground water contaminants (i.e., volatile, semi-volatiles, and metals). These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site report.

2.0 SUMMARY OF METHOD

In order to obtain a representative groundwater sample for chemical analysis it is important to remove stagnant water in the well casing and the water immediately adjacent to the well before collection of the sample. This may be achieved in a number of ways. Commonly used methods include but are not limited to the use of bailers and submersible pumps. When utilizing submersible pumps, low flow sampling is recommended.

Monitoring wells should be purged, at a minimum, the equivalent of three times the well volume of standing water or they should continue to be purged until specific conductance, temperature, and pH stabilize. The volume of water present in each well shall be computed based on the length of water column and well casing diameter. Once purging is completed, sampling may proceed. Care should be taken when choosing the sampling device as some will affect the integrity of the sample. If information about the contaminants levels in a well is known, then sampling should be performed in a progression from the least to most contaminated well.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The type of sample container, the preservative, holding time, and filtering requirements are all dependent upon the type of analysis to be performed upon the sample. This information should be clearly set forth in the Sampling and Analysis Plan (SAP) for the site. The sampler should consult the SAP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. Samples should be collected

directly from the sampling device (i.e. bailer or pump) into appropriate laboratory cleaned containers. Samples shall be appropriately preserved, labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample in accordance with the SAP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 General

The goal is to obtain a representative sample of the groundwater. Proper field sampling techniques need to be utilized in order to ensure that a representative sample is collected and the sampler does not compromise the sample through their actions. Analysis can be compromised by field personnel in two primary ways; taking an unrepresentative sample, or by incorrectly handling the sample. There are a number of ways to introduce contaminants into a sample that is why it is very important to following sampling protocols.

4.2 Purging

In a non-pumping well, there will be little or no vertical mixing of the water, thus stratification will occur. The well water in the screened section will mix with the ground water due to normal flow patterns, but the well water above the screened section will remain isolated, become stagnant, and may lack the contaminants representative of the ground water. Purging prior to sampling will help to ensure that stagnant water is not collected as a part of the sample.

In general, all monitor wells should be pumped or bailed prior to sampling. Purge three well volumes prior to collecting a sample. (*Note: In cases where it is not possible to purge three well volumes due to insufficient water levels, a minimum of one well volume should be purged*). When purging with a pump (not a bailer), the pump should be set at the screened interval. The sample should also be collected from the same depth within the screened interval that the pump was set at for purging. The well should be sampled as soon as practical after purging. For wells that can be pumped or bailed to dryness, the well should be evacuated and allowed to recover prior to collecting a sample.

A non-representative sample can also result from excessive pre-pumping of the monitoring well. Stratification of the leachate concentration in the ground water formation may occur, or heavier-than-water compounds may sink to the lower portions of the aquifer. Excessive pumping can dilute or increase the contaminant concentrations from what is representative of the sampling point of interest; therefore, it is important not to over purge a well.

5.0 EQUIPMENT/APPARATUS

The following are some of the materials and equipment that are potentially needed for groundwater well sampling activities:

- Water level indicator.
- Photoionization detector (PID).
- Logbook.
- Calculator.
- Field data sheets and samples labels.
- Chain of custody records and seals.
- Sample and shipping containers.
- Preservatives, as applicable.
- Pails, tubs, or buckets.
- Plastic sheeting.
- Packing materials and Ziploc plastic bags.
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water).
- Brushes.
- Pails or tubs.
- Clean, decontaminated or new unused bailers.
- Nylon line, enough to dedicate to each well.
- Sharp knife (locking blade).
- Submersible Pump.
- Generator (110, 120, or 240 volt) or 12 volt battery if inaccessible to field vehicle.
- PVC tubing.
- Hose clamps.
- Pump control box, if necessary.

6.0 REAGENTS

Reagents may be utilized for preservation of samples and for decontamination of sampling equipment. Refer to the SOP for the decontamination procedures and required reagents. Refer to the site-specific Sampling and Analysis Plan for the preservatives required for the specified analysis to be performed.

7.0 PROCEDURES

7.1 General Procedures

The following general procedures are applicable to all well sampling events.

1. Place plastic sheeting on the ground in the vicinity of the well to ensure that sampling equipment does not contact the ground surface.
2. Remove the well cap and check for volatile organics in the headspace using a PID. If concentrations are detected in the headspace above the action levels established in the Site Health and Safety Plan, appropriate personal protective equipment will be required.
3. Water-level measurement will be made using an electronic water level detector.

Typically, all depth measurements should be made from top (the highest point) of the inner well casing. The measuring point location should be described in the field log book and should be used in all subsequent sampling efforts. Lower the water-level measurement tape and record the depth to water and total depth of the well. Care should be taken to assure that the water-level measurement device hangs freely in the monitoring well and is not adhering to the wall of the well casing. Record water level data in the field logbook.

4. Prior to any sampling, measure the static water level and total depth of the well. Record the data and determine the well volume using one of the following formulas in Section 8.0 of this SOP. If more than 24 hours have passed since water levels were measured, check the static water level prior to purging for documentation purposes.

7.2 Bailer Method

1. Purge the well by manually bailing until a minimum of three well volumes have been removed and water quality parameters have stabilized within the following stabilization criteria over three consecutive readings. Record the purging and sampling data in the field logbook. *Note: if turbidity is stable, but not between 5 and 50 NTUs, the decision to continue sampling will be made by the Site Project Manager.*

Parameter	Criteria
pH	(0.1 standard units
Conductivity	(3 percent of readings
Temperature	(1.0 degree Celsius
Dissolved Oxygen	(10 percent of readings
Turbidity	(10 percent of readings (less than 10 nephelometric turbidity units (NTU), if possible
Eh	(10 millivolts)

2. Lower bailer slowly and gently into well, do not drop or splash bailer into the water. Stop lowering at desired point adjacent to well screen. Withdraw a sample from the well, transfer the sample from the bailer directly into sample containers. Preserve and filter according to the requirements set forth in the site-specific SAP.
3. Collect the samples in the following order:
 - Volatile organic compounds (ensure that volatiles are immediately capped and have no headspace).
 - Semi-volatile organic compounds.
 - Nitroaromatics.
 - Herbicides/pesticides.
 - Metals.

- All other parameters.
4. Samples for total metals analysis should be collected prior to sampling for dissolved metals. To collect samples for dissolved metals analysis, a 0.45 μ filter should be added to the discharge line. Samples for dissolved metals analysis should be collected after 500 ml of water has passed through the in-line filter. Remove the filter following collection of sample for dissolved metals.
 5. Label appropriate sampling containers with sampling details and custody information.
 6. Replace the well cap and lock the cover.
 7. Record the following information in the field log book:
 - Sample ID.
 - Location.
 - Purging and sampling data.
 - Color.
 - Odor.
 - Field screening instrument readings (i.e., water quality, PID).
 - Any other pertinent information.

7.3 Submersible Pump (Low Flow Sampling)

1. Calculate the total volume in the pump and tubing. Volume estimates per foot for common inside diameter tubing is presented in the following table:

Tubing Inside Diameter (inches)	Tubing Volume (gallons per foot)
1/4	0.0003
3/8	0.0057
1/2	0.010

2. Connect the pump tubing to the flow-through cell and connect the multi-parameter probe to the cell.
3. Lower the pump slowly in the well to minimize the disturbance of the water column.
 - Do not let the pump tubing, electrical cords, and support cable touch the ground as you are lowering the pump into place.
 - Secure the pump at the desired depth using the support cable. The entire pump and tubing assembly should be supported by a stainless steel or Teflon coated cable. It is not advisable to use the tubing to support the pump.

- Place the pump intake as close to the middle of the screened interval for wells with water levels above the top of the screen. For wells with water levels below the top of the screen, the pump intake should be placed midway between the depth to water and the bottom of the screened interval.
 - The pump or water level probe should not be allowed to hit the bottom of the well before or during sampling because it will disturb sediment. It should be noted that at least three feet of water is needed to implement low flow sampling.
4. Record the location of the pump intake (feet below the top of the casing) so that future sampling will occur at the same depth interval.
 5. Start the pump at the lowest possible flow setting. Increase the pump rate gradually until a continuous flow is achieved from the discharge tubing. The discharge rate of the pump can be determined by using a graduated cylinder and a stopwatch. Record the flow rate in gallons per minute. Pumping rates should be kept at minimal flow to ensure minimal drawdown in the monitoring well. The flow rate should be maintained between 0.03 and 0.13 gallons per minute throughout the purging and sampling activities.
 6. When a stable purge rate has been established, begin recording water quality readings at a frequency of every three to five minutes. Also, monitor and record water level and pump rate every three to five minutes during purging.
 7. Continue to purge the well until a minimum of three volumes of the tubing plus pump volume have been removed and water quality parameters have stabilized within the following stabilization criteria over three consecutive readings. Record the purging and sampling data in the field logbook.

Parameter	Criteria
pH	± 0.1 standard units
Conductivity	± 3 percent of readings
Temperature	± 1.0 degree Celsius
Dissolved Oxygen	± 10 percent of readings
Turbidity	± 10 percent of readings (less than 10 nephelometric turbidity units (NTU), if possible)
Eh	± 10 millivolts

8. Once the water quality parameters have stabilized, collect the ground water sample by detaching the tubing from the flow-through cell. Under no circumstances should the ground water sample be collected from the flow-through cell discharge stream. Collect the samples in the following order:

- Volatile organic compounds (ensure that volatiles are immediately capped and have no headspace).
 - Semi-volatile organic compounds.
 - Nitroaromatics.
 - Herbicides/pesticides.
 - Metals.
 - All other parameters.
9. Label the sample containers using indelible pen, place them in plastic bags, and place them on ice in a cooler. Record sample collection date and time. Handle and store samples in accordance with approved QAPP and/or SAP.
10. Remove the pump from the monitoring well. Decontaminate the pump and dispose of the tubing if it is non-dedicated to the well. Protect equipment from contamination by storing on plastic sheeting.
11. Close and lock the well.
12. Record the following information in the field log book:
- Sample ID.
 - Location.
 - Purging and sampling data.
 - Color.
 - Odor.
 - Field Screening Instrument Readings, if applicable.
 - Any Other Pertinent Information.

8.0 CALCULATIONS

If it is necessary to calculate the volume of the well, utilize the following equation:

$$\pi r_b^2 * h$$

or if the variables are known,

$$\pi r_{ic}^2 h + [(\pi r_b^2 h - \pi r_{oc}^2 h) * n_e]$$

Where

- r_{ic} = radius inside diameter of casing
- r_b = radius of borehole
- r_{oc} = radius outside diameter of casing
- h = water column height
- n_e = effective porosity of filter pack material ($\approx 35\%$)

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAP.
- The collection of an equipment rinsate blanks is recommended to evaluate potential for cross contamination from the purging and/or sampling equipment.
- The collection of duplicate samples will likely be required be a requirement set forth in the SAP /or Quality Assurance Project Plan (QAPP)
- Trip blanks are required if analytical parameters include analysis for volatile organic compounds.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with well sampling:

- Exposure to unknown contaminants.
- Lifting injuries associated with moving equipment, coolers with samples, and retrieving pumps and bailers.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slip, trip, and fall.

- Potential electrical shocks associated with use of submersible pumps.

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Ground Water Well Sampling, SOP# 2007, US EPA, Environmental Response Team, January 26, 1995

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005

Standard Operating Procedure For Ground Water Sampling, The Office of Environmental Measurement and Evaluation, EPA New England - Region 1, January 9, 2003

GROUNDWATER SAMPLING VIA DIRECT PUSH
SOP OER-0111

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration-Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	0.0	07/1/10	New SOP	Technical

GROUNDWATER SAMPLING VIA DIRECT PUSH

SOP OER-0111

Table of Contents

<u>Title</u>	<u>Page</u>
1.0 Scope and Application	3
2.0 Summary of Method	3
3.0 Sample Preservation, Containers, Handling, and Storage	3
4.0 Interferences and Potential Problems	3
5.0 Equipment/Apparatus	4
6.0 Reagents	4
7.0 Procedures	5
7.1 General Procedures	5
7.2 Check Valve Method	5
7.3 Mini-well Bailer Method	6
8.0 Calculations	7
9.0 Quality Assurance/Quality Control	7
10.0 Data Validation	8
11.0 Health and Safety	8
12.0 References	8

GROUNDWATER SAMPLING VIA DIRECT PUSH

SOP OER-0111

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide general reference information on sampling of groundwater using direct push (i.e. Geoprobe™) technology. The use of Geoprobe™ at a site for groundwater sampling allows for assessment of the potential for groundwater contamination without the costly installation of monitoring wells.

These procedures are designed to be used in conjunction with analyses for the most common types of ground water contaminants (i.e., volatile, semi-volatiles, and metals). These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site report.

2.0 SUMMARY OF METHOD

The Geoprobe™ is hydraulically powered and is generally mounted on a customized four-wheel drive vehicle. The base of the sampling device is positioned on the ground over the sampling location and the vehicle is hydraulically raised on the base. As the weight of the vehicle is transferred to the probe, the probe is pushed into the ground. A built-in hammer mechanism allows the probe to be driven through dense materials. Maximum depth penetration under favorable circumstances is approximately 50 feet. Slotted lengths of probe can be used to collect groundwater samples if the probe rods can be driven to the water table. Groundwater samples can be collected using a mini-well bailer, or a check valve.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The type of sample container, the preservative, holding time, and filtering requirements are all dependent upon the type of analysis to be performed upon the sample. This information should be clearly set forth in the Sampling and Analysis Plan (SAP) for the site. The sampler should consult the SAP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. Samples should be collected directly from the sampling device into appropriate laboratory cleaned containers. Samples shall be appropriately preserved, labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample in accordance with the SAP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

A preliminary site survey should be performed in order identify areas to be avoided with the Geoprobe™. All underground utilities should be located and marked. These areas were underground utilities are located should be avoided during sampling.

Decontamination of sampling tubes, probe rods, adaptors, non-expendable points and other equipment that contacts the soil and/or groundwater is necessary to prevent cross contamination of samples. During sampling, the bottom portion and outside of the sampling tubes can be contaminated with soil from other depth intervals. Care must be taken to prevent soil which does not represent the sampled interval from being carefully wiped from the outside surface of the sampling tube and the bottom 3 inches of the sample should be discarded before extruding the sample.

5.0 EQUIPMENT/APPARATUS

The following are some of the materials and equipment that are potentially needed for groundwater well sampling activities:

- Water level indicator.
- Photoionization detector (PID).
- Logbook.
- Calculator.
- Field data sheets and samples labels.
- Chain of custody records and seals.
- Sample and shipping containers.
- Preservatives, as applicable.
- Pails, tubs, or buckets.
- Plastic sheeting.
- Packing materials and Ziploc plastic bags.
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water).
- Brushes.
- Polyethylene tubing.
- Sampling gloves.
- Geoprobe™ and associated equipment (i.e., rods, extractor, drive and pull caps, expandable point holders, drive points).
- Threaded drive points.
- Mini-well bailer.
- Stainless steel perforated well screen.
- Stainless steel check valve.

6.0 REAGENTS

Reagents may be utilized for preservation of samples and for decontamination of sampling equipment. Refer to the SOP for the decontamination procedures and required reagents. Refer

to the site-specific Sampling and Analysis Plan for the preservatives required for the specified analysis to be performed.

7.0 PROCEDURES

These procedures relate to the sampling activities associated with collecting a groundwater sample from a GeoProbe™ and are not intended to address in detail the actual operation of the GeoProbe™. The operator should follow the SOP requirements established by the manufacturer for the GeoProbe™ model being utilized at the site.

7.1 General Procedures

1. Place plastic sheeting on the ground in the vicinity of the well to ensure that sampling equipment does not contact the ground surface.
2. The Geoprobe™ operator will advance the direct push rods to the desired depth of the boring. The operator will adhere to the SOPs established by the manufacturer for operation of the equipment being utilized to perform the work.

(Note: If contamination is observed in a perched aquifer during advancement of the rods, DO NOT push through into the next groundwater aquifer as you may introduce contamination.)

3. A water-level indicator should be used to determine if water has entered the slotted sections of the probe rod. If water is not detected in the probe rods, the operator will replace the drive cap and continue probing until water is reached.
4. After the probe rods have been driven into the saturated zone, sufficient time should be allowed for the water level in the probe rods to stabilize prior to performing sampling.
5. Groundwater samples may now be collected utilizing a check valve, a mini-well bailer, or a peristaltic pump.

7.2 Check Valve Method

1. Clean, unused polyethylene tubing with a decontaminated stainless steel check valve is then lowered down through the rods into the groundwater.
2. Groundwater is brought to the surface by lifting and lowering the tubing in the groundwater.
3. Once groundwater is brought to the surface, fill appropriate sample containers, seal, label, and place on ice. Take care not to overfill sample containers which would potentially

dilute preservatives.

(Note: At a minimum, groundwater temperature, pH, and specific conductivity will be measured and recorded during sampling. To minimize the potential for cross contamination, these measurements will be made on aliquots that are not submitted to the lab for analysis.)

4. The Geoprobe™ operator will remove the rods and tubing and fill the boring with bentonite chips and/or soil cuttings. The stainless steel rods, drive point assembly, and check valve will be decontaminated and the tubing will be disposed of as investigation derived waste.
5. Record the following information in the field log book:
 - Sample ID.
 - Location.
 - Purging and sampling data.
 - Color.
 - Odor.
 - Field Screening Instrument Readings, if applicable.
 - Any Other Pertinent Information.

(Note: Due to the nature of this collection procedure, solids that are not representative of the groundwater's natural condition are introduced into the sample. Therefore, filtering of direct push groundwater samples for metals, or other contaminants that tend to adhere to solids is recommended. Refer to the Sampling and Analysis Plan requirements to determine the appropriate samples that should be filtered.)

7.3 Mini-Well Bailer Method

1. A clean unused mini-well bailer is lowered down through the rods into the groundwater to collect the water.
2. Once groundwater is brought to the surface, fill appropriate sample containers, seal, label, and place on ice. Take care not to overfill sample containers which would potentially dilute preservatives.

(Note: At a minimum, groundwater temperature, pH, and specific conductivity will be measured and recorded during sampling. To minimize the potential for cross contamination, these measurements will be made on aliquots that are not submitted to the lab for analysis.)

3. The Geoprobe™ operator will remove the rods and tubing and fill the boring with bentonite chips and/or soil cuttings. The stainless steel rods, drive point assembly, and check valve will be decontaminated and the tubing will be disposed of as investigation derived waste.
4. Record the following information in the field log book:
 - Sample ID.
 - Location.
 - Purging and sampling data.
 - Color.
 - Odor.
 - Field Screening Instrument Readings, if applicable.
 - Any Other Pertinent Information.

(Note: Due to the nature of this collection procedure, solids that are not representative of the groundwater's natural condition are introduced into the sample. Therefore, filtering of direct push groundwater samples for metals, or other contaminants that tend to adhere to solids is recommended. Refer to the Sampling and Analysis Plan requirements to determine the appropriate samples that should be filtered.)

8.0 CALCULATIONS

No calculations are applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAP.
- The collection of an equipment rinsate blanks is recommended to evaluate potential for cross contamination.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAP /or Quality Assurance Project Plan (QAPP) for further information on collection of duplicate samples.

- Trip blanks are required if analytical parameters include analysis for volatile organic compounds.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with groundwater sampling using direct push technology:

- Exposure to unknown contaminants.
- Lifting and carrying injuries.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slip, trip, and falls.
- Injury from moving equipment.
- Underground utilities.
- Loud noises.

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Geoprobe™ Operation, SOP# 2050, US EPA, Environmental Response Team, March 27, 1996

Ground Water Well Sampling, SOP# 2007, US EPA, Environmental Response Team, January 26, 1995

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005

Model 5400 Geoprobe™ Operations Manual, Geoprobe™ Systems, Salina, Kansas. July, 27, 1990.

Geoprobe™® Screen Point 16 Groundwater Sampler, Standard Operating Procedure, Technical Bull

SOIL SAMPLING
SOP OER-0120

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration-Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	1.0	07/1/10	Reformatted, added SOP ID # and renumbered, supersedes Revision 0.0	Editorial
			Combined previous soil sampling SOP for surface and subsurface sampling, added sampling information	Technical

SOIL SAMPLING **SOP OER-0120**

Table of Contents

<u>Title</u>	<u>Page</u>
1.0 Scope and Application	3
2.0 Summary of Method	3
3.0 Sample Preservation, Containers, Handling, and Storage	3
4.0 Interferences and Potential Problems	4
5.0 Equipment/Apparatus	4
6.0 Reagents	4
7.0 Procedures	5
7.1 General Procedures	5
7.2 Surface Soil Samples	5
7.3 Sampling at Depth with Augers & Thin Wall Tube Samplers	6
7.4 Sampling at Depth with a Split Spoon (Barrel) Sampler	7
7.5 Test Pit/Trench Excavation	8
8.0 Calculations	9
9.0 Quality Assurance/Quality Control	9
10.0 Data Validation	10
11.0 Health and Safety	10
12.0 References	11

SOIL SAMPLING

SOP OER-0120

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of surface and subsurface soil samples using equipment such as a continuous flight auger, a split spoon, backhoe, hand auger, shovel, trowel, and/or scoop. Refer to SOP OER-0121 for soil sample collection procedures using direct push (i.e. GeoprobeTM). Analysis of soil samples may determine whether concentrations of specific pollutants exceed established action levels, or if the concentrations of pollutants present a risk to public health or the environment. These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site report. Refer to SOP OER-0122 for procedures for soil sampling of volatiles utilizing Method 5035. Refer to SOP OER-0101 and OER-0102 for procedures for field screening of soil with a photoionization detector (PID) and a X-Ray fluorescence (XRF) detector, respectively.

2.0 SUMMARY OF METHOD

Soil samples may be collected using a variety of methods and equipment depending on the depth of the desired sample, the type of sample required (disturbed vs. undisturbed), and the soil type. Surface and near-surface soils may be easily sampled using a spade, trowel, and scoop. Sampling at greater depths may be performed using a hand auger, continuous flight auger, a split-spoon, or a backhoe.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is generally not performed or recommended, except for Method 5035. However, samples should be cooled and protected from sunlight to minimize any potential reaction. The type of sample container, the preservative (if any), and holding times are all dependent upon the type of analysis to be performed upon the sample. This information should be clearly set forth in the Sampling and Analysis Plan (SAP) for the site. The sampler should consult the SAP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. Samples should be collected directly from the sampling device into appropriate laboratory cleaned containers. Samples shall be appropriately preserved (if applicable), labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample in accordance with the SAP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary potential problems associated with soil sampling - cross contamination of samples and improper sample collection. Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. Additionally, strictly following decontamination procedures of the non-dedicated sampling equipment can prevent or reduce the chance of cross contamination problems. Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in compaction of the sample, or inadequate homogenization of the samples where required, resulting in variable, non-representative results.

5.0 EQUIPMENT/APPARATUS

The following are some of the materials and equipment that are potentially needed for soil sampling activities. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- Photoionization detector (PID).
- Logbook.
- Field data sheets and samples labels.
- Chain of custody records and seals.
- Sample and shipping containers.
- Preservatives, as applicable.
- Pails, tubs, or buckets.
- Plastic sheeting.
- Packing materials and Ziploc plastic bags.
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water).
- Brushes.
- Sampling gloves.
- Shovel.
- Spatula, scoops, and/or trowels.
- Continuous flight (screw) auger.
- Bucket auger.
- Post hole auger.
- Split spoons.
- Drilling rig equipment (points, drive head, drop hammer, puller jack and grip, extension rods, T-handle, Thin wall tube sampler, etc.).
- Backhoe.

6.0 REAGENTS

Chemical preservation of solids is not generally recommended; therefore, reagents will likely be utilized only for decontamination of sampling equipment. Refer to the SOP for the

decontamination procedures and required reagents. Refer to the site-specific Sampling and Analysis Plan for the preservatives, if any, required for the specified analysis to be performed.

7.0 PROCEDURES

7.1 General Procedures

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required.
2. Obtain necessary sampling and monitoring equipment. Ensure that it has been decontaminated since its last use and ensure that the equipment is in good working condition.
3. Use stakes and/or flagging to identify and mark all sampling locations.
4. Ensure that Miss Utility and all local utilities have been called to perform a utility marking of the site.

7.2 Surface Soil Samples

The West Virginia Department of Environmental Protection Office of Environmental Remediation defines surface soil as the soil located from a depth of 0 to 2'. Collection of surface soil samples can be accomplished with tools such as spades, shovels, trowels, and scoops.

1. Clear any surface debris (e.g., vegetation, rocks, and twigs) from the sampling location.
2. Use a scoop, hand-auger, trowel, or shovel to collect a portion of soil from the 0-2 foot depth. Perform field screening as appropriate. If Method 5035 is required for volatiles, submerge the coring device directly into the soil contained in the sampling device and collect the sample placing the soil in the appropriate sample jar for volatile organic analysis. For all other analysis, the soil may be homogenized in a plastic bag or in a stainless steel bowl prior to placing the soil in the appropriate sample containers. (Note: Remove rocks, pebbles, and organic material from the soil sample prior to placing the soil in the sample containers).
3. Close the sample containers and affix labels to the containers and place on ice.
4. Measure the depth of the samples using a ruler, and record it in the field logbook.
5. Once the sampling is completed, dispose of disposable sampling equipment and plastic 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.

6. Record the following information in the field log book:
 - Sample ID.
 - Location.
 - Depth of sample.
 - Soil type description.
 - Equipment used.
 - Apparent moisture content (i.e., dry, moist, wet).
 - Color.
 - Odor.
 - Field Screening Instrument Readings, if applicable.
 - Any Other Pertinent Information.

7.3 Sampling at Depth with Augers and Thin Wall Tube Samplers

This system consists of an auger, or a thin-wall tube sampler, a series of extensions, and a "T" handle. The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin wall tube sampler. The system is then lowered down the borehole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin wall tube sampler.

The following procedure is used for collecting soil samples with the auger:

1. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, etc.).
2. Attach the auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
3. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole or into a 55 gallon drum. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods.
4. After reaching the desired depth, slowly and carefully remove the auger from the hole. When sampling directly from the auger, collect the sample after the auger is removed from the hole and proceed to Step 10.
5. Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.
7. Remove the tube sampler, and unscrew the drill rods.

8. Remove the cutting tip and the core from the device.
9. Discard the top 1” of the core as this may represent material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container.
10. Perform field screening as appropriate. If Method 5035 is required for volatiles, submerge the coring device directly into the soil contained in the sampling device and collect the sample placing the soil in the appropriate sample jar for volatile organic analysis. For all other analysis, the soil may be homogenized in a plastic bag or in a stainless steel bowl prior to placing the soil in the appropriate sample containers.
11. Once the sampling is completed, dispose of disposable sampling equipment and plastic 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.
12. Record the following information in the field log book:
 - Sample ID.
 - Location.
 - Depth of sample.
 - Soil type description.
 - Equipment used.
 - Apparent moisture content (i.e., dry, moist, wet).
 - Color.
 - Odor.
 - Field Screening Instrument Readings, if applicable.
 - Any Other Pertinent Information.
13. Abandon the boring in accordance with applicable state regulations.

7.4 Sampling at Depth with a Split Spoon (Barrel) Sampler

Split spoon sampling is generally used to collect undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted. When split spoon sampling is performed to gain geologic information, all work should be performed in accordance with ASTM D1586-98, “Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils”.

The following procedures are used for collecting soil samples with a split spoon:

1. Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top.
2. Using a well ring, drive the tube. Do not drive past the bottom of the head piece or compression of the sample will result.
3. Record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth.
4. Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The amount of recovery and soil type should be recorded on the boring log. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler is typically available in 2 and 3 1/2 inch diameters. A larger barrel may be necessary to obtain the required sample volume depending upon the analysis required.
5. Perform field screening as appropriate. If Method 5035 is required for volatiles, submerge the coring device directly into the soil contained in the sampling device and collect the sample placing the soil in the appropriate sample jar for volatile organic analysis. For all other analysis, the soil may be homogenized in a plastic bag or in a stainless steel bowl prior to placing the soil in the appropriate sample containers.
6. Once the sampling is completed, dispose of disposable sampling equipment and plastic 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.
7. Record the following information in the field log book:
 - Sample ID.
 - Location.
 - Depth of sample.
 - Soil type description.
 - Equipment used.
 - Apparent moisture content (i.e., dry, moist, wet).
 - Color.
 - Odor.
 - Field Screening Instrument Readings, if applicable.
 - Any Other Pertinent Information.
8. Abandon the boring in accordance with applicable state regulations.

7.5 Test Pit/Trench Excavation

The following procedures are used for collecting soil samples from test pits or trenches:

1. Using the backhoe, excavate a trench approximately three feet wide and approximately one foot deep below the cleared sampling location. Place excavated soils on plastic sheets. (Note: Trenches greater than five feet deep must be sloped or protected by a shoring system, as required by OSHA regulations.)
2. A shovel may be used to remove a one to two inch layer of soil from the vertical face of the pit where sampling is to be done.
3. Samples may be taken directly from the backhoe bucket using a shovel, trowel, scoop, or coring device. Be sure to scrape the vertical face at the point of sampling to remove any soil that may have fallen from above, and to expose fresh soil for sampling.
4. Perform field screening as appropriate. If Method 5035 is required for volatiles, submerge the coring device directly into the soil contained in the sampling device and collect the sample placing the soil in the appropriate sample jar for volatile organic analysis. For all other analysis, the soil may be homogenized in a plastic bag or in a stainless steel bowl prior to placing the soil in the appropriate sample containers.
5. Once the sampling is completed, dispose of disposable sampling equipment and plastic 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.
6. Record the following information in the field log book:
 - Sample ID.
 - Location and depth of sample.
 - Soil type description.
 - Equipment used.
 - Apparent moisture content (i.e., dry, moist, wet).
 - Color.
 - Odor.
 - Field Screening Instrument Readings, if applicable.
 - Any Other Pertinent Information.
7. Abandon the pit in accordance with applicable state regulations.

8.0 CALCULATIONS

No calculations are applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAP.
- The collection of an equipment rinsate blanks is recommended to evaluate potential for cross contamination.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAP /or Quality Assurance Project Plan (QAPP) for further information on collection of duplicate samples.
- Trip blanks are required if analytical parameters include analysis for volatile organic compounds.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with these soil sampling procedures:

- Exposure to unknown contaminants.
- Lifting and carrying injuries.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slip, trip, and falls.
- Injury from moving equipment.

- Underground utilities.
- Loud noises.

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Soil Sampling, SOP# 2012, US EPA, Environmental Response Team, February 18, 2000

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005

Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods, Second Edition, EPA-600/4-84-076, U.S. Environmental Protection Agency, 1984

SOIL SAMPLING USING GEOPROBE™
SOP OER-0121

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration-Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	0.0	07/1/10	New SOP	Technical

SOIL SAMPLING USING GEOPROBE™
SOP OER-0121

Table of Contents

<u>Title</u>	<u>Page</u>
1.0 Scope and Application	3
2.0 Summary of Method	3
3.0 Sample Preservation, Containers, Handling, and Storage	3
4.0 Interferences and Potential Problems	4
5.0 Equipment/Apparatus	4
6.0 Reagents	5
7.0 Procedures	5
8.0 Calculations	6
9.0 Quality Assurance/Quality Control	6
10.0 Data Validation	7
11.0 Health and Safety	7
12.0 References	8

SOIL SAMPLING USING GEOPROBE™

SOP OER-0121

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide general reference information on soil sampling using direct push (i.e. Geoprobe™) technology. Surface and subsurface soil sampling supplies information on subsurface lithology as well as providing data for use in evaluating the vertical and horizontal extent of chemical impact.

These procedures are designed to be used in conjunction with analyses for the most common types of soil contaminants (i.e., volatile, semi-volatiles, and metals). These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site report. Refer to SOP OER-0122 for procedures for soil sampling of volatiles utilizing Method 5035. Refer to SOP OER-0101 and OER-0102 for procedures for field screening of soil with a photoionization detector (PID) and a X-Ray fluorescence (XRF) detector, respectively.

2.0 SUMMARY OF METHOD

The Geoprobe™ sampling device is used to collect soil samples at specific depths below ground surface (bgs). The Geoprobe™ is hydraulically powered and is generally mounted on a customized four-wheel drive vehicle. The base of the sampling device is positioned on the ground over the sampling location and the vehicle is hydraulically raised on the base. As the weight of the vehicle is transferred to the probe, the probe is pushed into the ground. A built-in hammer mechanism allows the probe to be driven through dense materials. Maximum depth penetration under favorable circumstances is approximately 50 feet.

Soil samples are collected using specially designed sample tubes. The sample tube is pushed and/or vibrated to a specified depth. The interior plug of the sample tube is removed by inserting small diameter threaded rods. The sample tube is then driven an additional foot to collect the samples. The probe sections and sample tube are then withdrawn and the sample is extruded from the tube.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is not generally recommended, except for Method 5035. However, samples should be cooled and protected from sunlight to minimize any potential reaction. The type of sample container, the preservative (if any), and holding times are all

dependent upon the type of analysis to be performed upon the sample. This information should be clearly set forth in the Sampling and Analysis Plan (SAP) for the site. The sampler should consult the SAP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. Samples should be collected directly from the sampling device into appropriate laboratory cleaned containers. Samples shall be appropriately preserved (if applicable), labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample in accordance with the SAP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

A preliminary site survey should be performed in order identify areas to be avoided with the GeoprobeTM. All underground utilities should be located and marked. These areas where underground utilities are located should be avoided during sampling.

Decontamination of sampling tubes, probe rods, adaptors, non-expendable points and other equipment that contacts the soil is necessary to prevent cross contamination of samples. During sampling, the bottom portion and outside of the sampling tubes can be contaminated with soil from other depth intervals. Care must be taken to prevent soil which does not represent the sampled interval from being carefully wiped from the outside surface of the sampling tube and the bottom 3 inches of the sample should be discarded before extruding the sample.

Obtaining sufficient volume of soil for analysis of multiple parameters from one sample location may present a problem. The GeoprobeTM soil sampling system recovers a limited volume of soil and it is not possible to reenter the same hole and collect additional soil. When multiple analyses are to be performed on soil samples by this method, it is important that the relative importance of the analyses be identified. Identifying the order of importance will ensure that the limited sample volume will be used for the most crucial analyses. In some instances, it may be appropriate to push another boring very near the initial boring in order to have sufficient soil for all analysis. However, this should be clearly documented in the field notes and in the subsequent report for the site.

5.0 EQUIPMENT/APPARATUS

The following are some of the materials and equipment that are potentially needed for soil sampling activities. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- Photoionization detector (PID).
- Logbook.
- Field data sheets and samples labels.

- Chain of custody records and seals.
- Sample and shipping containers.
- Preservatives, as applicable.
- Pails, tubs, or buckets.
- Plastic sheeting.
- Packing materials and Ziploc plastic bags.
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water).
- Brushes.
- Sampling gloves.
- Geoprobe™ and associated equipment (i.e., rods, extractor, drive and pull caps, expandable point holders, drive points, piston rods and stops, sample tubes, vinyl end caps).

6.0 REAGENTS

Chemical preservation of solids is not generally recommended; therefore, reagents will likely be utilized only for decontamination of sampling equipment. Refer to the SOP for the decontamination procedures and required reagents. Refer to the site-specific Sampling and Analysis Plan for the preservatives, if any, required for the specified analysis to be performed.

7.0 PROCEDURES

These procedures relate to the sampling activities associated with collecting a soil sample from a Geoprobe™ and are not intended to address in detail the actual operation of the GeoProbe™. The operator should follow the SOP requirements established by the manufacturer for the GeoProbe™ model being utilized at the site. Ensure that Miss Utility and all local utilities have been called to perform a utility marking of the site prior to beginning work.

1. A decontaminated Geoprobe™ sampling spoon with an acetate or clear PVC liner is prepared at the surface and driven into the ground.
2. The sample spoon is closed on the end with a drive point and advanced to the top of the desired sample interval.
3. A pin is removed from the top of the sampler and the drive point is lifted out, thereby opening the bottom of the sampler, allowing soil to enter the sample spoon when the spoon is advanced.
4. The hydraulic hammer advances the Geoprobe™ sampling spoon to fill the acetate liner inside the sampler.
5. The sample spoon is then retrieved from the hole.

6. Immediately upon retrieval, the sample is opened, sliced into 6-inch lengths, and field screened with a photoionization detector and XRF, if applicable.
7. Sample intervals to be sent for laboratory analysis are extruded from the acetate liners into the appropriate containers. If volatiles are being sampled, use the Encore or Terra Core samplers (Method 5035) to collect a soil sample directly from the opened acetate sleeve. Refer to the SOP for Method 5035, as needed. Samples that will be analyzed for VOC's should be directly placed into the appropriate sample container without homogenizing or mixing. As appropriate, refer to the SOP for sampling method SW-846 5035. For non-volatile analytes may be placed in a stainless steel bowl or plastic bag and thoroughly homogenize. Fill the appropriate sample containers with the remaining homogenized sample.
8. Record the following information in the field logbook:
 - Sample ID.
 - Location.
 - Depth of sample.
 - Soil type description.
 - Equipment used.
 - Apparent moisture content (i.e., dry, moist, wet).
 - Color.
 - Odor.
 - Field Screening Instrument Readings, if applicable.
 - Any Other Pertinent Information.
9. Abandon the boring in accordance with applicable state regulations.

8.0 CALCULATIONS

No calculations are applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAP.

- The collection of an equipment rinsate blanks is recommended to evaluate potential for cross contamination.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAP /or Quality Assurance Project Plan (QAPP) for further information on collection of duplicate samples.
- Trip blanks are required if analytical parameters include analysis for volatile organic compounds.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with soil sampling using direct push technology:

- Exposure to unknown contaminants.
- Lifting and carrying injuries.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slip, trip, and falls.
- Injury from moving equipment.
- Underground utilities.
- Loud noises.

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities

requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Geoprobe™ Operation, SOP# 2050, US EPA, Environmental Response Team, March 27, 1996

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005

Model 5400 Geoprobe™ Operations Manual, Geoprobe™ Systems, Salina, Kansas. July, 27, 1990.

SOIL SAMPLING METHOD 5035
SOP OER-0122

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration-Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	1.0	07/1/10	Reformatted, added SOP ID # and renumbered, supersedes Revision 0.0 Additional detail provided	Editorial Technical

SOIL SAMPLING METHOD 5035
SOP OER-0122

Table of Contents

<u>Title</u>	<u>Page</u>
1.0 Scope and Application	3
2.0 Summary of Method	3
3.0 Sample Preservation, Containers, Handling, and Storage	3
4.0 Interferences and Potential Problems	4
5.0 Equipment/Apparatus	4
6.0 Reagents	4
7.0 Procedures	5
7.1 Encore® Sample Collection Method	5
7.2 Terra Core™ Sampling Method	6
8.0 Calculations	8
9.0 Quality Assurance/Quality Control	8
10.0 Data Validation	9
11.0 Health and Safety	9
12.0 References	9

SOIL SAMPLING METHOD 5035

SOP OER-0122

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide general reference information on sample collection procedures utilizing Method 5035. The use of Method 5035 is required for the LUST program and is applicable to the collection of volatiles for the Voluntary Remediation program. The procedures in this SOP may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site report.

2.0 SUMMARY OF METHOD

Method 5035 was adopted because of studies showing that sampling according to the previous methods resulted in significant losses of selected volatile organic compounds (VOCs). Method 5035 incorporates chemical preservatives and sample storage techniques to limit volatilization and biodegradation of VOCs. There are two collection options for Method 5035: an airtight coring device such as the Encore® sampler, or preserved vials (Terra Core™). The collection method determination should be based on holding time, laboratory-processing considerations, soil type (calcareous soils have special considerations when using the preserved vial option), and shipping considerations.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Samples collected with the Encore® Sampler do not require preservation other than being cooled to $\leq 6^{\circ}\text{C}$, but without freezing the sample. These samples should be extracted by the laboratory within 48 hours of the samples being collected. Samples collected by the Terra Core™ Method undergo chemical preservation. Three 40 ml vials are utilized in the Terra Core™ sampling method. Two of the vials have sodium bisulfate and the third has methanol as the preservative. After soil collection and preservation, the Terra Core™ samples should also be cooled to $\leq 6^{\circ}\text{C}$, but without freezing the sample.

The type of sample container, the preservative (if any), and holding times should be clearly set forth in the Sampling and Analysis Plan (SAP) for the site. The sampler should consult the SAP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. Samples should be collected directly from the sampling device into appropriate laboratory cleaned containers. Samples shall be appropriately preserved (if applicable), labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample in accordance with the SAP requirements. The samples should be shipped

with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Holding times for samples collected with the Encore® sampling equipment is 48-hours. This creates the need for overnight shipment and/or hand delivery to the laboratory. It also requires immediate attention to the samples by the analytical laboratory.

When using the Sampler, Calcareous soil samples may react upon contact with sodium bisulfate solution (Terra Core™ Sampling method) causing VOC loss through effervescence and potentially cause failure of the VOA vial septum through pressure buildup. Additionally, when soil samples are highly calcareous in nature, the sodium bisulfate preservative solution may not be strong enough to reduce the pH of the aqueous solution to below 2.0, potentially rendering the preservative useless.

5.0 EQUIPMENT/APPARATUS

The following are some of the materials and equipment that are potentially needed for soil sampling activities. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- Encore® Sampler.
- Terra Core™ sampler.
- Sample containers (Encore® air tight container or Terra Core™ which will consist of 40-ml vials with appropriate preservative and stirring bar).
- Photoionization detector (PID).
- Logbook.
- Field data sheets and samples labels.
- Chain of custody records and seals.
- Sample and shipping containers.
- Preservatives, as applicable.
- Packing materials.
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water).
- Brushes.
- Sampling gloves.
- Plastic bags.

6.0 REAGENTS

The Terra Core™ vials should come pre-prepared from the laboratory with the proper chemical preservatives (sodium bisulfate and methanol). Reagents for the decontamination of non-

disposable sampling equipment used to collect the soil samples will be required. Refer to the SOP for the decontamination procedures and required reagents.

7.0 PROCEDURES

7.1 Encore® Sample Collection Method

1. Clear any surface debris (e.g., vegetation, rocks, twigs) from the sampling location.
2. Before taking the sample, hold the coring body and push plunger rod down until small o-ring rests against tabs. This will assure that plunger moves freely.
3. Depress locking lever on Encore® T-Handle. Place coring body, plunger end first, into open end of T-Handle, aligning the (2) slots on the coring body with the (2) locking pins in the T-Handle. Twist coring body clockwise to lock pins in slots. Check to ensure sampler is locked in place. Sampler is ready for use.
4. Turn T-Handle with T-up and coring body down. This positions plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push sampler into soil until coring body is completely full. When full, small o-ring will be centered in T-Handle viewing hole. Remove sampler from soil. Wipe excess soil from coring body exterior.
5. Cap coring body while it is still on T-handle. Push cap over flat area of ridge. Push and twist cap to lock arm in place. Cap must be seated to seal sampler.
6. Remove the capped sampler by depressing locking lever on T-Handle while twisting and pulling sampler from T-Handle. Lock plunger by rotating extended plunger rod fully counter-clockwise until wings rest firmly against tabs.
7. Place the capped sampler back into the Encore® sample zipper bag and label. Seal the bag and put on ice. Samples collected with the Encore® method should be analyzed within 48 hours or preserved by the laboratory within 48 hours.
8. Record the following information in the field logbook:
 - Sample ID.
 - Location.
 - Depth of sample.
 - Soil type description.
 - Equipment used.
 - Apparent moisture content (i.e., dry, moist, wet).

- Color.
- Odor.
- Field Screening Instrument Readings, if applicable.
- Any Other Pertinent Information.

7.2 Terra Core™ Sampling Method

1. A determination of whether the sample will be considered high (>200 µg/Kg) or low (0.5-200 µg/Kg) concentration should be performed. This may be based on DQOs, expected concentrations, or regulatory limits. If the expected concentrations cannot be estimated prior to sampling, and/or DQOs or other considerations indicate the need for both concentration levels, both low and high concentration aliquots should be collected. Refer to the Table below for appropriate sample containers for high/low sample concentrations.

Sample Container and Preservative Requirements for Samples Collected by the Terra Core™ Method

Concentration of Volatiles Solid Type	<200 ug/kg	>200 ug/kg	Unknown Concentrations
Non-Reactive	3-40 ml vials with 5 ml of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of methanol weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹ AND 3-40 ml vials with 5 ml of methanol weight checked to the nearest 0.01gram ¹
Reactive	3-40 ml vials with 5 ml of organic free reagent water weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of methanol weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of organic free reagent water weighed to the nearest 0.01gram ¹ AND 3-40 ml vials with 5 ml of methanol weighed to the nearest 0.01gram ¹
Unknown	3-40 ml vials with 5 ml of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹ AND 3-40 ml vials with 5 ml of organic free reagent water weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of methanol weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹ AND 3-40 ml vials with 5 ml of organic free reagent water weighed to the nearest 0.01gram ¹ AND 3-40 ml vials with 5 ml of methanol weighed to the nearest 0.01gram ¹

¹ The vials will be pre-weighed by the laboratory to the nearest 0.01gram. If the required weight check is performed in the field, a variance of up to 0.2 grams is allowed. If the required weight check is performed in the laboratory, a variance of up to 0.01 gram is allowed. Weight checks should be performed within 24 hours of use.

2. Prior to adding solid to any vial, the individual vial should be checked to ensure that the weight of the vial and preservative have been written on the vial by the laboratory.
3. Clear any surface debris (e.g., vegetation, rocks, twigs) from the sampling location.
4. Have ready a 40ml glass volatile organic analysis (VOA) vial containing the appropriate preservative. With the plunger seated in the handle, push the Terra Core™ into freshly exposed soil until the sample chamber is filled. A filled chamber will deliver approximately 5 grams of soil.
5. Wipe all soil or debris from the outside of the Terra Core™ sampler. The soil plug should be flush with the mouth of the sampler. Remove any excess soil that extends beyond the mouth of the sampler.
6. Rotate the plunger that was seated in the handle top 90° until it is aligned with the slots in the body. Place the mouth of the sampler into the 40ml VOA vial containing the appropriate preservative, and extrude the sample by pushing the plunger down. Quickly place the lid back on the 40ml VOA vial.

Note: When capping the 40ml VOA vial, be sure to remove any soil or debris from the threads of the vial.

7. Place the containers in a plastic bag and seal. Store sample on ice at approximately 4°C and deliver to the laboratory.
8. Record the following information in the field logbook:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field Screening Instrument Readings, if applicable
 - Any Other Pertinent Information

8.0 CALCULATIONS

No calculations are applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAP.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAP /or Quality Assurance Project Plan (QAPP) for further information on collection of duplicate samples.
- Trip blanks are required if analytical parameters include analysis for volatile organic compounds.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the potential hazards associated with this SOP.

- Exposure to unknown contaminants
- Exposure to chemical reagents and preservatives
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE
- Slip, trip, and falls

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005

Test Methods for Evaluation of Solid and Hazardous Wastes, SW 846 Method 5035, US Environmental Protection Agency, Washington, DC 1998.

APPENDIX C

**TITLE 47
LEGISLATIVE RULES
DIVISION OF ENVIRONMENTAL PROTECTION
OFFICE OF WATER RESOURCES**

**SERIES 32
REGULATIONS GOVERNING ENVIRONMENTAL LABORATORIES
CERTIFICATION AND STANDARDS OF PERFORMANCE**

§47-32-1. General.

1.1. Scope. -- This rule governs the certification of laboratories conducting environmental analysis of waste and wastewater performed as required by rules or orders issued pursuant to the covered statutory programs. The rule establishes the provisions for obtaining and maintaining laboratory certifications and the criteria and procedures laboratories will be required to follow in analyzing samples.

1.2. Authority. -- W. Va. Code §22-1-15.

1.3. Filing Date. -- May 1, 1995.

1.4. Effective Date. -- May 1, 1995.

1.5. Incorporation by Reference. -- The Division hereby adopts and incorporates into this rule the approved "Guidelines Establishing Test Procedures for the Analysis of Pollutants" 40 CFR 136, EPA SW 846 Methods, and such other methods as may be approved by U.S. Environmental Protection Agency (EPA) or the Director.

1.6. Construction. -- This rule shall be liberally construed to permit the division of environmental protection to discharge its statutory functions and to effectuate the purposes of the laboratory certification program.

1.7. Purpose of this Rule. -- This rule is promulgated to insure that the results of environmental analyses are accurate, reproducible and verifiable. This purpose will be achieved by:

1.7.1. Establishing the administrative procedures to be followed by certified laboratories and laboratories seeking certification;

1.7.2. Establishing the categories and parameters in which laboratories may be certified;

1.7.3. Establishing the minimum requirements, criteria and procedures for laboratory equipment and supplies, practices, methodology, quality control, personnel, facilities, data reporting, and laboratory and record maintenance, which a certified laboratory shall continually meet; and

1.7.4. Establishing the enforcement procedures the division will follow to ensure that all certified laboratories or laboratories seeking certification are in compliance with this rule.

1.8. Certification Program Requirements.

1.8.1. A laboratory analyzing samples for compliance with adopted rules, permits, or orders issued pursuant to a covered statutory program will follow the procedures set forth in this rule in order to obtain and maintain certification. The provisions of this rule are only applicable to tests required by State and Federal regulatory programs.

1.8.2. Certified laboratories and laboratories seeking certification will analyze all samples requiring testing under this rule in accordance with the procedures and methods required by this rule.

1.9. Program Information and Communications. -- Questions concerning the requirements of this rule should be directed to the Division of Environmental Protection, Office of Water Resources, Quality Assurance Program, 1201 Greenbrier Street, Charleston, WV 25311.

§47-32-2. Definitions.

2.1. "Accredited" means an approval conferred upon institutions or programs where appropriate by a nationally recognized accrediting agency or association as determined by the Division.

2.2. "Analyte" means an element, ion or compound of interest to the analyst.

2.3. "Analytical Reagent Grade" (AR), "ACS reagent grade", and "Reagent Grade" are synonymous terms for reagents which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

2.4. "APHA Standard Methods" or "Standard Methods for the Examination of Water and Wastewater" means the methods published by the American Public Health Association, 1015 Fifteenth Street NW, Washington, DC 20005.

2.5. "Approved analytical methods" are those analytical or test methods cited in the Code of Federal Regulations as being approved by EPA or such other methods as shall be approved by the Director.

2.6. "Category" means a group of parameters for which certification is offered.

2.7. "Certification" means the approval granted by the chief authorizing a laboratory to provide environmental compliance data.

2.8. "Certification parameter" means a parameter which is identified in a performance evaluation sample test and that is used to evaluate the overall analytical performance of a laboratory on the specific method.

2.9. "Certification year" is that period of time following the date upon which the laboratory first receives certification for any parameter or category and lasting for 365 consecutive days.

2.10. "Certified thermometer" is a thermometer that has documentation from the manufacturer showing that it has been compared

The following words and terms, when used in this rule have the following meanings unless the context clearly indicates otherwise.

against a National Institute for Standards Testing (NIST) thermometer covering the temperature ranges employed by the laboratory.

2.11. "CFR" means the Code of Federal Regulations.

2.12. "Chief" means the Chief of the Division of Environmental Protection's Office of Water Resources.

2.13. "Compliance analysis" means the analysis of a sample that is required to be analyzed by a division rule, permit or order.

2.14. "Covered statutory programs" means one of the regulatory programs developed under statutory authority of one of the following acts of the Legislature:

2.14.1. Water Pollution Control Act, WV Code §22-11-1.

2.14.2. Hazardous Waste Management Act, WV Code §22-18-1.

2.14.3. Hazardous Waste Emergency Response Fund Act, WV Code §22-19-1.

2.14.4. Underground Storage Tank Act, WV Code §22-17-1.

2.14.5. Solid Waste Management Act, WV Code §22-15-1.

2.14.6. Groundwater Protection Act, WV Code §22-12-1.

2.15. "Division" means the West Virginia Division of Environmental Protection, Bureau of Environment.

2.16. "Director" means the director of the West Virginia Division of Environmental Protection, Bureau of Environment. The Director may designate the Chief of the Office of Water Resources to administer this rule.

2.17. "EPA" and "USEPA" means the United States Environmental Protection Agency.

2.18. "Laboratory" means a facility conducting tests or analyses of parameters for which certification is required, where the results of such tests or analyses are used for purposes of demonstrating compliance under the covered statutory programs. Provided; The term "laboratory" shall not include individuals conduct-

2.20. "Laboratory seeking certification" means an uncertified laboratory which has submitted an acceptable application and the appropriate fee.

2.21. "Parameter" means an analytical method or test within a category and for which certification is offered.

2.22. "Performance evaluation sample" means a sample containing a known amount of a specific or combination of parameters used in part to evaluate the performance of a laboratory.

2.23. "Person, Persons, or applicant" means any industrial user, public or private corporation, institution, association, firm or company organized or existing under the laws of this or any other state or country; state of West Virginia; governmental agency, including federal facilities; political subdivision; county commission; municipal corporation; industry; sanitary district; public service district; drainage district; soil conservation district; watershed improvement district; partnership; trust; estate; person or individual; group of persons or individuals acting individually or as a group; or any legal entity whatever.

2.24. "Personal and direct supervision" means that a supervisor is available either in person or on call at all times when laboratory procedures are being performed.

2.25. "Primary Standard" means a highly pure reagent used as a reference for standardizing other reagent solutions.

2.26. "Quality Assurance Program" means a regulatory program developed to achieve the purposes of subsection 1.7 of this rule for the covered statutory programs of the Division of Environmental Protection.

ing analyses of constituents that must be conducted in the field because of practical constraints; such as, but not limited to pH, dissolved oxygen, total residual chlorine and sulfide.

2.19. "Laboratory pure water" means distilled or deionized water which is free of contaminants that interfere with analytical tests.

2.27. "Raw Data" means that data acquired in the process of collecting and analyzing samples for compliance testing purposes. Raw data includes such sampling report forms, sample log books, laboratory bench sheets, calculations and formulas, and analytical data and notes as are used during sample analysis. Raw data may be in the form of graphs, line recorder charts, handwritten data, or computer printouts made at or near the time of the analysis or sample collection.

2.28. "Replicate sample" means a sample prepared by dividing a homogeneous sample into separate parts so that each part is also homogeneous and representative of the original sample.

2.29. "Standard curve" means a curve plotting concentrations of a known parameter standard minus a blank, versus the standard's absorbance or percent transmittance or other instrument response.

2.30. "Supervisor" means that designated person responsible for the technical adequacy and quality of data for a certification category, and who possesses the qualifications required under subsection 3.7 of this rule.

§47-32-3. Certification Program; Application, Procedures, and Requirements.

3.1. Requirements of Certification.

3.1.1. With the exception of those tests not normally performed in a laboratory proper, all sample analyses required by order of the Division or performed for the purpose of determining compliance with chemical, microbiological, aquatic toxicity and radiological requirements of the State's covered statutory programs must be performed in laboratories certified for this purpose pursuant to this rule. Analyses performed in laboratories not so certified shall not be accepted

by the Division as being in compliance with the requirements, rules or orders of the Division. All analyses not performed in a laboratory proper must be performed by personnel under the direction of a supervisor from a certified laboratory.

3.1.2. Laboratories doing business in other states where a state certifying agency grants reciprocal certification, approval, or other authorization to laboratories located in West Virginia, and which is certified, approved or authorized by the agency of that state having primary certification responsibility under Federal programs delegated to such other state under conditions equivalent to those required by this rule, are considered to be certified for the purpose of this rule once they have complied with the provisions of Section 3.4. Laboratories doing business in other states where certification is not required, and who are not certified in another state, may be considered for certification by following the conditions and requirements stated in Section 3.3.

3.1.3. Only laboratories certified pursuant to this rule or maintained by the EPA may be called West Virginia Certified Environmental Laboratories and no laboratory may adopt any name or make any oral or written statement intended or likely to mislead the public with respect to its certification status.

3.2. Categories of Certification. -- A laboratory applying for certification in one or more of the following categories must demonstrate acceptable performance on performance evaluation samples, where available, and meet all other requirements of this rule. The laboratory certificate will specify the categories and the parameters within each category for which the laboratory is certified and it must be displayed in a location visible to the public. Tests for all categories, except Aquatic Toxicity, must be conducted in accordance with the method and procedures specified in the Code of Federal Regulations, Chapter 40 as appropriate, or other methods that may be approved by EPA or the Director. The certification categories are:

3.2.1. Atomic Absorption, Emission Spectroscopy, and Flame Photometry -- which comprises tests or analyses for which the atomic absorption methods are applicable or required.

3.2.2. Limited Chemistry -- which comprises chemical tests or analyses except those for which the atomic absorption, gas chromatography and/or mass spectrometry methods are specifically required.

3.2.3. Gas Chromatography (GC) and Mass Spectrometry (MS) -- which comprises tests for which the GC and/or MS methods are applicable or required.

3.2.4. Microbiology -- which comprises tests for Coliform Bacteria, Fecal Streptococci, Pathogenic Bacteria, Plate counts, Viruses, Parasites and Paracite ova.

3.2.5. Aquatic Toxicity -- testing which must be conducted in accordance with the methods and procedures specified in Standard Methods or EPA 600/4-85-013 et.seq. (acute) or EPA 600/4-89-001 et.seq. (chronic) or other methods that may be approved by EPA or the Director;

3.2.6. Radiological.

3.2.7. Characteristics -- which include Corrosivity, Ignitability, Reactivity, Extraction Procedure Toxicity and Toxic Characteristic Leaching Procedure.

3.3. Application Procedures and Requirements for Laboratories Located in West Virginia.

3.3.1. A person operating a laboratory in West Virginia who wants to be certified in one or more of the categories and parameters thereof or, who if already certified, wants to add a category or a parameter within a category, must apply for certification to the West Virginia Division of Environmental Protection, Quality Assurance Program, refer to subsection (1.9) of this rule for address. The applicant shall submit the appropriate fee with the application for certification.

3.3.2. An application for certification is acceptable when a complete application is submitted. This includes the appropriate fee, and the information requirements of this rule for the category, categories or parameter(s) for which certification is requested. Acceptance of a complete application does not authorize the laboratory to perform analyses regulated by this

rule. The applicant will be notified of the acceptance and the laboratory inspected to determine if it is in compliance with the requirements of this chapter prior to the issuance of certification.

3.3.3. An application will be rejected without prejudice for not being a complete application.

3.3.4. Performance evaluation samples will be a part of this inspection. Proficiency testing will be in accordance with subsection 3.10 of this rule. Following acceptable analytical values for the performance evaluation samples the Quality Assurance office will contact the laboratory to arrange a mutually acceptable date for an on-site inspection. Certified laboratories that desire to extend the range of tests or analyses offered must demonstrate satisfactory results in testing Performance Evaluation samples for these additional parameters.

3.3.5. The results of the analysis or testing of performance evaluation samples shall be considered in determining whether the certification of the laboratory should be granted, renewed, denied, revoked, or suspended. Certification may be granted only for those parameters for which the laboratory performs acceptably.

3.3.6. An applicant for certification who either does not perform acceptably on the performance evaluation samples or does not meet the requirements of this rule shall be notified by Certified Mail that certification has been denied. Laboratories notified of certification denial must immediately cease performing analyses required of a certified laboratory by this rule or the covered statutory programs.

3.3.6.a. Applicants receiving a notification of certification denial may not reapply for certification until the laboratory assures the Quality Assurance Office in writing that all reasons for certification denial have been rectified.

3.3.6.b. Owners, principal officers, managers or supervisors of a laboratory, for which certification has been denied, may not reapply for certification of this same facility by simply changing the company or laboratory name.

3.3.6.c. Certification is transferable. A laboratory facility must, on a form prescribed by the director, notify the Division at the address listed in subsection 1.9 of this rule that the facility is being sold or has a change of principal officer(s), manager(s) or supervisor(s).

3.3.7. Certifications may contain conditions requiring correction of minor deficiencies identified by the Quality Assurance Officer by a date or dates specified therein.

3.3.8. The following special provisions are applicable to the phase-in of the West Virginia Environmental Laboratory Certification Program:

3.3.8.a. Laboratories in operation upon the effective date of this rule may continue to conduct tests and analyses for compliance purposes for a period of 60 days following the effective date of this rule. Within the 60 days following the effective date of this rule, laboratories that desire to continue performing tests and analyses for compliance purposes must complete and submit, on a form prescribed by the Director, an Application for Certification specifying the tests and analyses for the parameter(s) for which the laboratory seeks certification, along with the appropriate fee for such application, as established under subsection 3.6 of this rule. Laboratories that have submitted a complete application and the appropriate fee to the Director within the 60 days following the effective date of this rule may continue to perform tests and analyses for the parameters listed in the application until the Director takes final action upon the application.

3.3.8.b. Laboratories conducting tests and analyses for compliance purposes prior to certification as provided in subparagraph 3.3.8.a of this rule must follow the procedures and requirements of all applicable EPA test methods or other methods approved by the Director.

3.3.8.b.A. Laboratories that fail to acceptably analyze performance evaluation samples will be granted two additional opportunities within 60 days of notification of such failure to successfully analyze the samples for such parameters that the laboratory has been unsuccessful in analyzing, as provided in paragraph 3.10.7 of this rule.

3.3.8.b.B. Laboratories that otherwise fail to meet the requirements of this rule will be allowed to continue to conduct tests and analyses if within 15 days of notification of such deficiencies, the laboratory submits to the Director a plan to correct the deficiencies. A plan accepted by the Director, with or without revision, will afford the laboratory 60 days from the date of notification of acceptance to correct such deviations in accordance with the approved plan. The 60 day period may be extended if the Director determines that more than 60 days is necessary to correct the deficiencies in accordance with the approved plan.

3.4. Application Procedures and Requirements for Laboratories Not Located in West Virginia.

3.4.1. Owners of laboratories located in a state other than West Virginia, which have been certified, approved or otherwise authorized by that state's agency having primary certification, approval or authorization responsibility for laboratory certification programs with conditions equivalent to those required by this rule, and who have entered into a reciprocity agreement with West Virginia, and who wishes to perform analyses covered by this rule for West Virginia clients shall:

3.4.1.a. Annually complete the application form provided by the Division's Quality Assurance Office;

3.4.1.b. Have the form certified by the state agency having primary certification authorization/enforcement responsibility; and

3.4.1.c. Return the form to the Quality Assurance Office of West Virginia at the address listed in subsection 1.9 of this rule.

3.4.2. The application will be reviewed and if found to be complete the laboratory will be certified or recertified.

3.4.3. If the laboratory's certification, approval or authorization is revoked by the state agency having primary certification, approval or authorization responsibility, the West Virginia certification is automatically canceled for the same parameter(s) as has been revoked in the other state.

The laboratory manager shall notify the West Virginia Quality Assurance Office and all clients in West Virginia of the revocation within 48 hours of receipt of notice of revocation.

3.4.4. The owner of a laboratory in a state other than West Virginia which is not certified by that state or is certified under conditions not equivalent to those required by this rule and who wishes to perform analyses for West Virginia clients may apply for certification in accordance with the procedure set forth in subsection 3.3 of this rule. In addition, prior to conducting the on-site laboratory inspection, the laboratory shall submit to the Quality Assurance Office a per diem sum the Division determines to be sufficient to cover the travel, room, and board expenses of the certification inspector(s).

3.5. Renewal of Certification. -- Applications for renewal of certification must be submitted, on forms provided therefor, no later than 60 days before the expiration date of certification, and accompanied by the appropriate fee. A laboratory submitting an application for renewal of certification may continue to operate under the previous certification until the Quality Assurance Office notifies the laboratory of the approval or denial of renewal.

3.6. Fees.

3.6.1. Owners of Laboratories applying for certification or renewal of certification, shall submit the appropriate fee obtained from the following annual fee schedule for each category in which the laboratory seeks certification for one or more parameters, along with the required application materials. Fees are nonrefundable.

NOTE: SEE TABLE 1 ATTACHED.

3.6.2. Laboratories owned or operated by the State of West Virginia or an agency of the Federal Government are exempt from the above fees, but shall make appropriate application for certification in accordance with the other provisions of this rule.

3.6.3. All application fees collected under this rule will be paid into a special state treasury fund designated the "Environmental Labo-

ratory Certification Fund" which will be used to defray the cost of administering this rule.

3.7. Required Laboratory Personnel Qualifications.

3.7.1. Each laboratory must have one individual designated as the person responsible or in charge and irrespective of any local title or designation, is herein referred to as the laboratory manager.

3.7.2. Current employee records must include a resume documenting each employee's training, degrees held, experience, duties, and date(s) of relevant employment. This provision is applicable only to the employees laboratory and environmental sampling work history.

NOTE: SEE TABLE 2 ATTACHED.

3.7.3. Laboratory supervisors who are also laboratory technicians and who do not have the required laboratory experience will be considered a Supervisor-in-Training and must have their work reviewed by an individual meeting the above education and experience requirements for supervisors.

3.7.4. Those persons in a supervisory position upon the effective date of this rule are not subject to the above education requirements of this rule. Those persons who do not meet the above minimum experience requirements upon the effective date of this rule may remain in a supervisory position as a Supervisor-in-Training until such time as experience requirements have been met.

3.8. Duties and Responsibilities of Laboratory Personnel.

3.8.1. The laboratory manager or his designee will administer the operations of the laboratory including the approval of test and analysis results.

3.8.2. Each laboratory supervisor shall provide personal and direct supervision for technical personnel and for the reporting of tests and analyses.

3.9. Management of Laboratories.

3.9.1. A certified laboratory may offer as a service those laboratory tests, analyses, or procedures that are within the category or categories for which it is certified.

3.9.2. A laboratory that is certified shall only report analytical data for samples which are properly labeled, and for which there is reasonable assurance the samples have been collected, preserved, stored and transported in such a manner as to assure identity, stability of the sample, and proper analysis.

3.10. Proficiency Testing.

3.10.1. Except when determined by the Quality Assurance Office that an appropriate performance evaluation test is not readily available, all certified laboratories or laboratories seeking certification shall participate in an annual performance evaluation testing program covering all tests and analyses made available within the category, categories or parameter(s) for which the laboratory is certified or seeks certification.

3.10.2. The Quality Assurance Office or its authorized agent will send to the laboratory, at the laboratory's expense, a set of performance evaluation samples, if available, for the parameters for which certification is requested, but only following acceptance of the laboratory's application by the Division.

3.10.3. Laboratories certified or those seeking certification must test or analyze the performance evaluation samples and submit the results to the Quality Assurance Office or its authorized agent, as appropriate, within the time frame allowed each participant testing that set of samples for evaluation. Any laboratory found to send performance evaluation samples to another laboratory for testing will be denied certification and not allowed to reapply for certification for a period of five (5) years from the date of the denial.

3.10.4. The laboratory will have satisfied the requirements for testing for a parameter when it acceptably analyzes the range of values for that parameter, within a given set of performance evaluation samples, for which the laboratory seeks certification.

3.10.5. The laboratory will be informed of the results of such evaluation by the agency providing the test samples. For those parameters for which a laboratory has not successfully completed the performance evaluation after three attempts, the laboratory will be reevaluated upon written request.

3.10.6. Acceptable analysis for a value occurs when the reported value falls within the 99 percent confidence interval calculated for that sample from available performance evaluation data.

3.10.7. The laboratory will have three separate opportunities within 90 days to acceptably analyze one of three different sets of performance evaluation samples for any parameter for which the laboratory seeks certification. The laboratory need only repeat performance evaluation tests for those parameters for which the laboratory has failed to perform acceptably. Parameters for Organic Samples shall mean a method, or method subdivision (i.e. Volatiles, Extractables, BTEX, etc.). Laboratories that fail to successfully analyze at least one of the three different sets of performance evaluation samples in the time period allotted will not be reevaluated for a period of one year from the last failure.

3.11. Laboratory Inspections.

3.11.1. As a condition of obtaining and maintaining certification, a laboratory will permit and facilitate inspections by personnel of the Division. This inspection will include the physical facilities as well as laboratory records and reports.

3.11.2. The Division will conduct at least one on-site inspection of a laboratory seeking certification to determine whether or not the laboratory meets the Quality Assurance Office standards as set forth in this rule.

3.11.3. Regular inspections of laboratories certified in accordance with this rule will be conducted during reasonable hours at intervals of not more than two years.

3.11.4. Authorized representatives of the Division may make inspections of a certified or an interim approved laboratory whenever the Division in its discretion considers such inspections

necessary. A laboratory's refusal to allow entry to the Division's representative will be grounds for denial or revocation of certification.

3.11.5. During inspections, consideration will be given to staff competence, working conditions, testing or analytical methods used, quality control procedures, maintenance of records and compliance with the requirements of this rule.

3.11.6. The laboratory will be furnished with a copy of the inspection report which will list deficiencies found, and a listing of the parameters for which the laboratory has demonstrated proficiency during the inspection.

3.12. Cancellation, Suspension, and Revocation of Certification.

3.12.1. Any certified laboratory may cancel its certification in any category or parameter by notifying the Quality Assurance Office in writing of the laboratory's decision to cancel its certification. The laboratory will enclose its Environmental Laboratory Certification with the letter of notification. This cancellation notification will not entitle the laboratory to any refund of fees paid.

3.12.2. Whenever any deviations from the requirements of this rule are found, the laboratory shall comply with the provisions of paragraph 3.3.8 and parts 3.3.8.b.A and 3.3.8.b.B.

3.13. Effect and Duration of Suspension and Revocation.

3.13.1. The results of any tests or analyses performed after the effective date of a suspension or revocation order for any category or parameter will not be accepted by the Division as compliance with the requirements for NPDES reporting.

3.13.2. Suspension or revocation will not be withdrawn until all basis for the suspension or revocation have been eliminated or rectified.

3.14. Notice of Changes -- In the event there are any changes in the name, location, ownership, address, telephone number or supervisory personnel of the laboratory to which the provisions of this rule apply, then the laboratory will imme-

diately submit written notice thereof to the Division. For supervisory personnel this provision applies only to those whose responsibilities include analyses that must be made in compliance with this rule.

§47-32-4. Laboratory Requirements.

A certified laboratory or a laboratory seeking certification must continually meet and follow the requirements of this section.

4.1. Laboratories will have on the premises and under the control of the laboratory manager all of the equipment and instruments necessary to analyze each parameter in which the laboratory is certified, or is seeking certification. All equipment must meet the minimum standards required by the test method used.

4.2. General Requirements for All Laboratories.

4.2.1. Adequate laboratory space and facilities must be available to properly carry out the services performed in, or offered by, the laboratory.

4.2.2. Laboratory work areas will be arranged so as to minimize problems in contamination, transportation and communication.

4.2.3. Workbench space within the laboratory must be ample for the tests or analyses to be performed, have adequate lighting and be convenient to a sink, water, gas, suction and electrical outlets as necessary to properly carry out the specific tests or analyses to be performed.

4.2.4. Temperature and humidity within the laboratory are to be maintained within the limits required for the proper performance of each test or analysis, the proper operation of the various instruments, and the proper storage of expendable supplies.

4.2.5. Each laboratory will have available adequate equipment and instruments necessary to properly perform the tests and analyses for the parameters within the categories for which the laboratory is certified or is seeking certification.

4.2.6. pH meters must have an accuracy of and scale graduations within 0.1 standard unit.

4.2.7. Analytical and pan balances are to be clean, not corroded, and be provided with Class-S weights. Analytical balances will be capable of weighing to 0.1 milligram minimum. Pan balances will be capable of weighing to 100 milligrams.

4.2.7.a. An analytical balance must be mounted on a heavy, shockproof table. The balance level must be checked frequently and adjusted as necessary;

4.2.7.b. An analytical balance must be located in an area that is not near laboratory traffic and is protected from sudden drafts and humidity changes; and

4.2.7.c. Two Class-S weights are to be available for checking the analytical balance, one in the gram range and one in the milligram range.

4.2.8. Glass or metal thermometers will be graduated in one degree centigrade (or 2 degrees Fahrenheit) increments and readable to 0.5 degrees centigrade (1 degree Fahrenheit) for all analyses except fecal coliform analysis; in which case glass or metal thermometers are to be readable to 0.2 degrees centigrade.

4.2.8.a. Continuous temperature recording devices will be sensitive and accurate to within 1.0 degree centigrade (2 degrees Fahrenheit).

4.2.8.b. The column of liquid in glass thermometers will have no separation.

4.2.8.c. Thermometers must be calibrated annually for glass types and quarterly for metal types against a certified thermometer traceable to a National Institute for Standards Testing thermometer. See also subparagraph 5.2.2.g of this rule for additional thermometer requirements.

4.2.9. Sample storage refrigerators must maintain an internal temperature of 1 to 4 degrees centigrade.

4.2.10. Laboratory glassware, plastic ware, and metal utensils will meet the following requirements:

4.2.10.a. Glassware and metal utensils must resist corrosion, and be capable of withstanding high temperatures, and vigorous cleaning;

4.2.10.b. Flasks, beakers, dilution bottles, culture dishes, culture tubes and other glassware are to be of borosilicate glass and free of chips, cracks, and excessive etching;

4.2.10.c. Volumetric glassware should be Class A and need not be calibrated before use. Non Class A glassware must be calibrated before use; and

4.2.10.d. Metal utensils must be made of stainless steel or other inert material.

4.2.11. Pipettes must meet the following requirements:

4.2.11.a. Glass pipettes are to be made of borosilicate glass.

4.2.11.b. Plastic pipettes must be compatible with the reagents being measured, i.e. will not dissolve or show signs of etching or numbers being removed;

4.2.11.c. Plastic pipettes may be used for microbiological procedures only;

4.2.11.d. Pipettes must deliver the required volume quickly and accurately within a 2.5 percent tolerance; and

4.2.11.e. Pipettes must not be excessively etched, nor the mouthpiece or delivery tips chipped, or the graduation marks illegible.

4.2.12. Magnetic stirrers must have variable speeds, and use Teflon coated stirring bars.

4.3. Criteria and Procedures for Microbiological Testing.

4.3.1. The Division incorporates from the latest approved edition of APHA

Standard Methods and Microbiological Methods for Monitoring the Environment, EPA 600/8-78-017 et.seq., or such other methods as may be approved by EPA or the Director, all the standards, criteria, sample and analytical procedures and methodology, quality assurance and quality control specifications for evaluation and certification purposes under subsection 4.3 of this rule.

4.3.2. Laboratory pure water will be analyzed for the parameters listed in the following table. Should the test results for any of the substances exceed the standards set forth in the table, corrective action must be taken and the water retested.

NOTE: SEE TABLE 3 ATTACHED.

4.4. Criteria for Chemical, Gas Chromatography and Mass Spectrometry Testing and Analysis -- The Division incorporates from the latest approved edition of APHA Standard Methods, Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020 et.seq., and US-EPA SW-846 manuals, or such other methods as may be approved by EPA or the Director, all the standards, criteria, sample and analytical procedures and methodology, quality assurance and quality control specifications for evaluation and certification purposes under subsection 4.4 of this rule.

4.5. Criteria and Procedures for Toxicity Testing -- All work is to be performed in accordance with procedures out-lined in APHA Standard Methods and/or in Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms, EPA 600/4-85-013 et.seq., or Short Term Methods for Estimating Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA 600/4-89/001 et.seq. or such other methods as may be approved by EPA or the Director for the test to be performed.

4.6. Criteria and Procedures for Radiochemical Testing.

4.6.1. The types of radiation counting systems needed to comply with this rule are described in 40 CFR 136. Laboratories are required to have on the premises and under the control of

the laboratory manager those instruments needed to analyze for those activities or specific radionuclides for which the laboratory is certified.

4.6.2. Laboratories must use the analytical procedures specified in Chapter 40 of the Code of Federal Regulations, or such other procedures as may be approved by EPA or the Director.

§47-32-5. Methodology, Quality Control and Record Keeping.

5.1. Methodology.

5.1.1. Sample collection, handling, and preservation technique specified in Chapter 40 of the Code of Federal Regulations, or other procedures approved by EPA or the Director are to be followed.

5.1.1.a. Samples requiring preservation will be preserved at the time of collection.

5.1.1.b. Sample collection, handling and preservation techniques specified by the analytical methods will be followed for the parameters analyzed by those methods.

5.1.1.c. The sample report form (chain of custody) must be completed immediately after collection and will state the sampling location, date and time of collection, collector's name, and any remarks.

5.1.1.d. After the sample has been collected, the appropriate information as to identity of the sample is to be written on the label. The label must remain affixed to the sample container and is not to be removed until the required analyses have been completed and the surplus sample has been discarded.

5.1.1.e. Immediately upon delivery of the sample to the laboratory, the sample collector will complete the appropriate chain of custody section of the sample report form or chain of custody form. A chain of custody form is not required where the sampler is also the analyst and in situations where the laboratory and the sample site(s) are within the property boundaries of the facility in which the laboratory is located.

5.1.1.f. Prior to accepting custody of a sample, laboratory personnel must be reasonably assured that the sample has met the preservation requirements. If the sample fails to meet these requirements, the sample chain of custody form is to be marked indicating the sample was improperly preserved.

5.1.1.g. When it is necessary to send samples by mail, bus, courier service, or private shipping, the chain of custody form is to be completed by the sampler and is to accompany the samples during shipping. Upon receipt of the samples in the laboratory, the provisions of subparagraph 5.1.1.f of this rule are to be followed.

5.1.2. Test procedures identified in Chapter 40 of the Code of Federal Regulations, or other methods approved by EPA or the Director will be utilized for the analysis of all samples required to be reported to the Division of Environmental Protection.

5.1.2.a. All procedures other than those set forth in paragraph 5.1.2 of this rule are considered alternative analytical methods. Laboratories must make special application to the Division for the use of alternative analytical methods and such application must include a showing of acceptable comparability data.

5.1.2.b. All laboratories which have previously been granted approval to use an alternate analytical method by the US EPA will be allowed to continue using such method after it submits written proof of the approval to the Division.

5.1.3. General Laboratory Practices.

5.1.3.a. Chemistry.

5.1.3.a.A. Laboratories utilizing visual comparison devices must calibrate the standards incorporated into such devices at least once every four months. The laboratory will make and maintain records of the date and method of each such calibration.

5.1.3.a.B. Distilled and deionized water is to have at a minimum, resistivity values between 0.5 - 2.0 megohms-cm (2.0 - 0.5 umhos/cm) at 25 degrees centigrade.

5.1.3.a.C. Analytical Reagent grade chemicals should be used for most analyses. Detailed information on reagent grades is set forth in the approved analytical methods and their recommendations must be followed for the reagent quality to be used for each test or analysis.

5.1.3.a.D. Determine method detection limits for all Limited Chemistry, Atomic Absorption, Gas Chromatography/Mass Spectroscopy parameters tested. Method found in 40 CFR part 136 must be used for this calculation.

5.1.3.a.E. Field blanks, field duplicates and trip blanks must be performed on those test categories named in part 5.1.3.a.D of this rule, at a minimum of two times per year, one during the cold wet season and one during the warm dry season.

5.1.3.b. Microbiology.

5.1.3.b.A. Laboratory sterilization procedures are to meet the requirement of 121 degrees centigrade and the time adjusted for the type and volume of material to be sterilized as specified in the standardized methods.

5.1.3.b.B. Membrane filter assemblies must be sterilized after each sample filtration series, the end of which is marked by the lapse of 30 minutes or more between sample filtrations.

5.1.3.b.C. At least two minutes of ultraviolet light or boiling water may be used on a membrane filter assembly to prevent bacterial carry-over between filtrations.

5.1.3.b.D. Dried glassware may be sterilized in a hot air oven at 170 centigrade for a minimum of two hours.

5.1.3.b.E. Media may be prepared from dehydrated media stock or commercially prepared ampouled media may be used for routine bacteriological procedures.

5.1.3.b.F. Rinse water and dilution water used by the laboratory must be prepared according to instructions in the

standardized methods and the final pH adjusted to 7.2 ± 0.1 .

5.1.3.c. Aquatic Toxicity Testing.

5.1.3.c.A. Natural or artificial sources of water may be used, but natural sources are preferred.

5.1.3.c.B. Natural sources are to be free of pollution, low in turbidity, high in dissolved oxygen, low in B.O.D., and the pH must be favorable to the maintenance of the organisms.

5.1.3.c.C. Municipal water supplies are acceptable. Water from a municipal source must be passed through a filter to remove organic chemicals and chlorine before use, and conditioned for the species under test.

5.1.3.c.D. Test organisms are to be fed as outlined in Methods of Measuring Acute Toxicity, EPA manual 600/4-85-013.

5.1.3.c.E. Treatment of diseased or parasitized organisms is to be in accordance with the procedures given in APHA Standard Methods and Methods for Measuring Acute Toxicity, EPA manual 600/4-85-013.

5.1.3.c.F. Organisms treated for disease or parasites are not to be used in aquatic toxicity tests for at least 10 days after treatment.

5.1.3.d. Radiochemistry.

5.1.3.d.A. Analytical reagent grade (AR) chemicals will be used for all analyses, unless otherwise required for an individual analytical procedure.

5.1.3.d.B. Radioactive standards and radioactive wastes are to be stored in an enclosed and properly labeled area, either within the laboratory or in a separate room or facility. All radioactive materials must be safely stored in suitable containers.

5.1.3.d.C. Standards and samples are to be prepared in an area of the laboratory specifically designated for and exclusively used for the preparation of radioactive standards

and samples. Adequate precautions must be taken in this area to ensure against radioactive contamination.

5.1.3.e. Gas Chromatography / Mass Spectrometry -- Equipment must be capable of meeting the quality control requirements specified in paragraph 5.2.6 of this rule.

5.2. Quality Control Programs -- Each laboratory will develop, and have on file available for inspection a written description of the current laboratory Quality Assurance Program Plan. This written description will outline the procedures which the laboratory uses in meeting the quality control requirements set forth in this subsection. Managers, supervisors, and analysts should participate in developing the quality control program. Each participant within the laboratory is to have access to a copy of the quality control program and the detailed guidelines for implementation of the participant's responsibility. A record of analytical control tests and quality control checks on media, materials, and equipment will be prepared by the laboratory and retained for at least three years.

5.2.1. A written description includes, but need not be limited to, the following for each category:

5.2.1.a. Procedures which the laboratory will use in meeting the quality control requirements of this rule pertaining to laboratory equipment and instrumentation, and the frequency with which such procedures will be performed.

5.2.1.b. Each laboratory will develop a written laboratory procedures manual which sets forth, in detail, the methods which the laboratory will use in chemical analyses for all parameters for which the laboratory is seeking certification.

5.2.1.c. Each laboratory must record and retain all raw data and calculations derived from analyses and quality control procedures in a manner that will provide easy verification of the data and calculations during on-site inspections.

5.2.2. Limited Chemistry and Atomic Absorption laboratories must perform the following internal quality control checks:

5.2.2.a. Each analytical balance, with the exception of electronic balances without internal calibration controls, is to be checked and adjusted annually by a balance service technician. The accuracy of each analytical balance must be checked on each day of use using at least two Class-S weights, one in the gram range and one in the milligram range. The weights used, weight detected, dates on which checks were performed, analyst, and other pertinent information is to be recorded in a log book. The daily weighing check will be used as an indication of proper operation of electronic balances.

5.2.2.b. The wavelength setting of the spectrophotometer is to be checked yearly by comparing the wavelength setting to the absorption maxima of colored standards of filters such as didymium glass or by using standard Cobalt Chloride solution which has a maximum absorbance at a wavelength of 510 nM. The check data is to be recorded in a log book.

5.2.2.c. pH meters are to be calibrated prior to usage with two pH buffer standards bracketing the value to be measured and the calibration recorded.

5.2.2.d. Conductivity meters must be checked over the range of the instrument using at least five concentrations of standard solutions yearly. The cell constant, k , is to be determined from this data. The meter must be calibrated using at least one standard with each use. The results of these calibrations must be recorded in a log book.

5.2.2.e. A daily record of the drying oven temperature must be maintained for each day on which the drying oven is in use. The oven thermometer must be kept in a sand bed or other inert material.

5.2.2.f. The temperature of each refrigerator and each incubator is to be either recorded continuously or recorded daily from in-place thermometers immersed in liquid and placed on one of the shelves being used. The refrigerator thermometer must be kept in a low vapor pressure liquid such as 50/50 water/Ethylene Glycol.

5.2.2.g. The accuracy of all thermometers used to monitor temperatures will be verified by comparing the readings of such thermometers with the readings of a certified thermometer. Glass thermometers are to be verified yearly and metal thermometers quarterly. A record of each thermometer identification and the results of the test are to be kept in a log book.

5.2.2.h. Standard curves consisting at a minimum of one reagent blank and 4 standards are to be prepared for each analysis requiring such a curve. This curve will be verified in each subsequent analyses by using at least one reagent blank and one standard at or near the concentration levels normally encountered in such analyses. Such verifications are considered satisfactory if the results are within 10 per cent of the original curve when following vendor approved procedures for instrument calibration.

5.2.2.i. Standard curves used in the analysis of parameters in the Atomic Absorption category will be prepared as stated above in subparagraph 5.2.2.h of this rule except that a minimum of one reagent blank and 2 standards are required.

5.2.2.j. In all cases where possible, replicate sample analyses are to be conducted for parameters in the Limited Chemistry and Atomic Absorption categories to verify the precision of the method. Replicate analyses will be performed at a frequency of 5 percent. Where less than 20 samples are analyzed at one time the analyst is to verify the precision once per analysis batch.

5.2.2.k. In all cases where possible, spiked sample analyses will be conducted to verify the accuracy of the method at the same frequency as set forth in subparagraph 5.2.2.j of this rule. Documentation will be made of both precision and accuracy testing.

5.2.2.l. In all cases where possible, standard deviations are to be calculated and documented for all applicable measurements being conducted in the Limited Chemistry and Atomic Absorption categories (spiked sample recoveries). Standard deviations must be documented in tabular form and on control charts.

5.2.3. Microbiology.

5.2.3.a. A start and finish MF sterile control test of rinse water, media and supplies will be conducted for each sample filtration series. If the control tests indicate contamination, then all data which has been generated through tests involving the use of the contaminated materials will be rejected and the laboratory must request immediate resampling of those waters involved in the laboratory error.

5.2.3.b. The MPN test must be carried through the "confirmed" stage for Fecal Coliform.

5.2.4. Aquatic Toxicity Testing -- An acceptable degree of precision for definitive toxicity tests is the 95 percent confidence level or fiducial intervals within less than + 30 percent of the 48 hour or incipient LC50 value.

5.2.4.a. A reference toxicant test is to be performed to establish the validity of effluent toxicity data generated by bioassay laboratories.

5.2.4.b. Reference toxicant materials are available from the Environmental Protection Agency, Environmental Support Laboratory, Cincinnati, Ohio. Instructions for their use and the expected LC50 values are provided with the samples.

5.2.4.c. The reference toxicant test must be conducted within 7 days immediately preceding an effluent toxicity test or concurrently with the toxicity test.

5.2.4.d. A control chart, as described in Methods of Measuring Acute Toxicity-EPA manual should be prepared for each reference toxicant/organism combination, and successive LC-50's plotted and examined to determine if the results are within prescribed limits.

5.2.4.e. If the LC-50 of reference toxicant does not fall in the expected range for the test organisms, the sensitivity of the test system is suspect. In this case, the test procedure should be examined for defects, and a different batch of test organisms should be employed in repeating the reference toxicant and effluent toxicity test.

5.2.5. Radiochemistry -- Permanent records must be maintained of preventive maintenance, periodic inspections, testing, and calibration for the proper operation of radiation instruments and analytical balances; validation of methods; evaluation of reagents and volumetric equipment; surveillance of results; and remedial actions taken in response to detected defects. Such records must be kept on file by the laboratory for a period of at least five years.

5.2.5.a. To verify internal laboratory precision, duplicate analyses equal to ten percent of sample analyses shall be performed. The differences between duplicate measurements shall be less than twice the standard deviation of the specific analysis as described in Environmental Radioactivity Laboratory Intercomparison Studies Program, EPA 600/4-77-001 et.seq.

5.2.5.b. One background and one calibration standard must be tested each day at a 5 percent level or fraction thereof.

5.2.5.c. Work records of quantitative tests are to indicate final results together with all corresponding instrument readings and calculations. Where instrumentation produces tracings or printouts, such tracings or printouts may serve as the work record.

5.2.6. Gas Chromatography and Mass Spectrometry.

5.2.6.a. The frequency and procedures for satisfying each of the requirements listed in subparagraphs 5.2.6.b and 5.2.6.c of this rule are described in detail in EPA publication SW-846, Chapter 40 of the Code of Federal Regulations, and/or in the US EPA Contract Laboratory Program Statement of Work for Organics Analysis.

5.2.6.b. Minimum quality control operations necessary to satisfy the analytical requirements associated with the determination of semi-volatile and volatile organic compounds by gas chromatographic methods will include the following:

5.2.6.b.A. Evaluation of Appropriate Blank Materials.

5.2.6.b.B. Surrogate Spike Response Monitoring.

5.2.6.b.C. Matrix Spike and Duplicate Analyses.

5.2.6.b.D. Verification of Response and Calibration.

5.2.6.b.E. Conformational Analysis.

5.2.6.c. Minimum quality control operations to satisfy the analytical requirements associated with gas chromatographic/mass spectrometry determinations of semi-volatile and volatile compounds will be as follows:

5.2.6.c.A. Documentation of GC/MS Mass Calibration and Tune Abundance Patterns.

5.2.6.c.B. Documentation of GC/MS Response Factor Stability.

5.2.6.c.C. Internal Standard Response and Retention Time Documentation.

5.2.6.c.D. Surrogate Spike Recovery Monitoring

5.2.6.c.E. Matrix Spike and Duplicate Analyses.

5.3. Records and Data Reporting.

5.3.1. Records of analyses, including but not limited to all raw data, calculations, quality control data, and laboratory reports, are to be kept by the laboratory for at least three years unless otherwise specified.

5.3.2. The following information is to be retained by the laboratory as part of the records of analysis and the records of custody:

5.3.2.a. The laboratory number or other form of identification of the sample;

5.3.2.b. The date, time, specific site of sampling, and the name of the person who collected the sample or the laboratory which submitted the sample;

5.3.2.c. The date and time when the laboratory received the sample, whether the sample was received preserved or unpreserved;

5.3.2.d. The date and time of analysis of the sample;

5.3.2.e. The person or persons who performed the analysis;

5.3.2.f. The type of analysis performed and the analytical method or methods employed;

5.3.2.g. The results of the analysis and the raw data generated by the analysis; and

5.3.2.h. The name and address of the laboratory to which the sample was forwarded, if the analysis was not performed at the laboratory which first received the sample.

5.3.3. If the chain of custody information is reported on a chain of custody form, a copy of the form must be attached to the sample report form.

5.3.4. The results of each analysis are to be calculated and entered on the sample report form which is to be forwarded to the person requesting the analysis of the sample. A careful check is to be made to assure that each result entered on the sample report form is the same as the result entered on the bench sheet.

5.3.5. The original or true duplicate of the results of the test or analysis is to be sent promptly to the person who requested such tests or analysis, and must be signed by the laboratory manager or a designee whose designation has been submitted to the Division in writing.

5.3.6. Whenever a laboratory refers samples to another laboratory, the person ordering the examination is to receive the original laboratory report or a true duplicate of that report on the form of the laboratory that actually performed the test or analysis.

5.3.7. If results are entered into a computer storage system, a printout of the data must be verified with the raw data.

§47-32-6. Appeals.

Appeal to Environmental Quality Board -- Any person aggrieved or adversely affected by an order or action of the Director made and entered in accordance with the provisions of this rule or by issuance or denial of certification under the provisions of this rule, may appeal to the Environmental Quality Board in the same manner as appeals are taken under W. Va. Code §22B-1-7 to have the order vacated or modified. The filing of a notice of appeal will not automatically stay an order or action of the Director. The Environmental Quality Board will be reimbursed from the Environmental Laboratory Certification Fund for expenses incurred for appeal hearings filed with the Board relative to the provisions of this rule.

TABLE 1:

**ENVIRONMENTAL LABORATORY CERTIFICATION
ANNUAL FEE SCHEDULE**

Limited Chemistry	\$25.00 per analyte or parameter
Atomic Absorption.....	\$10.00 per metal
Gas Chromatography/Mass Spectroscopy	\$500.00 for 600 or SW846 series methods each
Microbiology.....	\$50.00 per parameter per method
Aquatic Toxicity	\$500.00 Acute or Chronic each
Radiochemistry	\$500.00
Hazardous Waste Characteristics.....	\$100.00 per procedure

TABLE 2:
EDUCATION & EXPERIENCE REQUIREMENTS
FOR SUPERVISORS

CERTIFICATION CATEGORY	EDUCATION + (Years)(1)	EXPERIENCE (Years)(2)	SPECIAL REQUIREMENTS
Limited Chemistry & Microbiology	12 14 16	+ + +	2 or 1 or 1 ETC Certificate(3)
Atomic Absorption absorption	16	+	2(4) 2 years of which must be in atomic
Gas Chromatography chromatography	16	+	2(4) 2 years of which must be in gas
Mass Spectrometry	16	+	2(4) 2 years of which must be in mass
Aquatic Toxicity testing	16	+	2(4) 2 years of which must be in aquatic toxicity
Radiochemistry chemistry	16	+	2(4) 2 years of which must be in radio

Notes:

- (1) 12 years = High School diploma or GED.
14 years = 2 years of college with emphasis in laboratory technology or a natural science.
16 years = Bachelors degree in Chemistry, Biology, Environmental Science, or other natural science.
- (2) Substitution -- 1 year of laboratory experience within the specific certification category may be used for each year of education beyond 12 years.
- (3) ETC Certificate = Environmental Training Center Laboratory Technician Certificate required of all POTW laboratory supervisors.
- (4) No substitution is allowed for the 2 years of minimum experience required.

TABLE 3:

QUALITY OF PURIFIED WATER USED IN MICROBIOLOGY TESTS

<u>Test</u>	<u>Monitoring Frequency</u>	<u>Limit</u>
<u>Chemical Tests:</u>		
Conductivity	With each use	>0.5 megohms resistance or <2 umhos/cm at 25 degrees centigrade
pH	With each use	5.5 - 7.5
Heavy Metals (single)	Annually	<0.05 mg/L
Cd, Cr, Cu, Ni, Pb, Zn (total)	Annually	<0.10 mg/L
Ammonia/Organic N	Monthly	<0.10 mg/L
Total Chlorine Residual	with each use	< detection limit
<u>Bacteriological Tests:</u>		
Heterotrophic Plate count	Annually	<1000 colonies/mL

APPENDIX D

OER Inspection Forms and Checklists

WVDEP/OER Incident Report



west virginia department of environmental protection
Office of Environmental Remediation

INCIDENT REPORT

- ☐ Confirmed Release
☐ Suspected Release
☐ Complaint

Date: Time:
Callers Name:
Phone #:

FACILITY ID# LEAK ID# INVESTIGATOR:
LOCATION NAME: STREET:
CITY: STATE: COUNTY: ZIP:
PHONE: () OPERATOR:
WERE TANKS LAST USED AFTER DECEMBER 22, 1998? ☐ Yes ☐ No
SPECIFIC LOCATION:

PRIORITY CODE: 1 ☐ 2 ☐ 3 ☐ (1 BEING HIGHEST) CLOSURE #:
.65 LETTER REQUIRED: YES ☐ NO ☐ REASON FOR .65 LETTER 1 ☐ 2 ☐ 3 ☐ 4 ☐
WELLHEAD PROTECTION AREA: YES ☐ NO ☐

RESPONSIBLE PARTY INFORMATION

OWNER NAME: STREET:
CITY: STATE: ZIP:
PHONE: () CONTACT PERSON:

SITE STATUS HISTORY

CONFIRMED RELEASE DATE:
LUST CLEANUP INITIATED DATE:
EMERGENCY RESPONSE TAKEN WITH: STATE ☐ FEDERAL ☐ RP ☐
COMMENTS:

IMPACT TO RECEPTORS

☐ IMPACTED 1. Business ☐ 2. Home ☐ 3. Public ☐ 4. Surface Water ☐
5. Utilities ☐ 5. Soil ☐ Vapor ☐ Dissolved ☐ Free Product ☐
☐ IMMINENT 1. Business ☐ 2. Home ☐ 3. Public ☐ 4. Surface Water ☐
5. Utilities ☐ 5. Soil ☐ Vapor ☐ Dissolved ☐ Free Product ☐
☐ POTENTIAL 1. Business ☐ 2. Home ☐ 3. Public ☐ 4. Surface Water ☐
5. Utilities ☐ 5. Soil ☐ Vapor ☐ Dissolved ☐ Free Product ☐
RELEASE INFORMATION: GASOLINE ☐ DIESEL ☐ OTHER ☐
TANK ☐ PIPE ☐ SPILL ☐ OVERFILL ☐

LEAK/COMPLAINT INFORMATION:
ACTION TAKEN:

Completed By:

Date:

COMMENTS:

LUST Site Visit Report



west virginia department of environmental remediation
Office of Environmental Remediation

LEAK #:
WV ID#:
DATE:

LEAKING UNDERGROUND STORAGE TANK SITE VISIT REPORT

<u>OWNER</u>				<u>OPERATOR</u>			
Name:	<input type="text"/>			Name:	<input type="text"/>		
Address:	<input type="text"/>			Address:	<input type="text"/>		
City:	<input type="text"/>	State:	<input type="text"/>	City:	<input type="text"/>	State:	<input type="text"/>
Zip:	<input type="text"/>			Zip:	<input type="text"/>		
Phone:	<input type="text"/>	<input type="text"/>	<input type="text"/>	Phone:	<input type="text"/>	<input type="text"/>	<input type="text"/>

<u>LOCATION OF TANKS</u>			
Facility:	<input type="text"/>		
City:	<input type="text"/>	County:	<input type="text"/>
Date of Last Visit:	<input type="text"/>	Consultant:	<input type="text"/>
Time on Site:	<input type="text"/>	Reason for Visit:	<input type="text"/>
Clean Up Initiated Date:	<input type="text"/>	Site Under Control Date:	<input type="text"/>
Clean Up Complete:	<input type="text"/>		

COMMENTS:

Project Status Checklist



west virginia department of environmental protection
Office of Environmental Remediation

PROJECT STATUS CHECKLIST

LEAK # WVID # CLOSURE # Priority Code Update:

Site Name: Site Location:

- ☐ Confirmed release
- ☐ Cleanup initiated: ☐ Biopile proposal submitted:
- ☐ Request for state assistance (state lead site) Original attached
- ☐ Received 45 day report (280.63). Original attached
- ☐ Received free product report (280.64). Original attached
- ☐ Request for 280.65 report ☐ Received 280.65 report
- ☐ Request for 280.66 plan ☐ Received 280.66 plan
- ☐ Approved 280.66 plan
- ☐ Implemented 280.66 plan
- ☐ Site Investigation complete
- ☐ Site Cleanup completed

Project Manager/Geologist:

Date:

COMMENTS:

Site Visit/Inspection Report



west virginia department of environmental remediation
Office of Environmental Remediation

VRP Project #:
Brownfield Site: Yes ☐ No ☐
Report Date:
Page of

OFFICE OF ENVIRONMENTAL REMEDIATION
VOLUNTARY REMEDIATION PROJECT
SITE VISIT/INSPECTION REPORT

<u>APPLICANT</u>			<u>LRS</u>		
NAME: <input type="text"/>			NAME: <input type="text"/>	LRS# <input type="text"/>	
ADDRESS: <input type="text"/>			ADDRESS: <input type="text"/>		
CITY: <input type="text"/>	STATE: <input type="text"/>	ZIP: <input type="text"/>	CITY: <input type="text"/>	STATE: <input type="text"/>	ZIP: <input type="text"/>
PHONE: (<input type="text"/>) <input type="text"/>			PHONE: (<input type="text"/>) <input type="text"/>		
CONTACT: <input type="text"/>					

<u>LOCATION</u>		
FACILITY: <input type="text"/>	STREET ADDRESS: <input type="text"/>	
CITY: <input type="text"/>	COUNTY: <input type="text"/>	PHONE: (<input type="text"/>) <input type="text"/>
DATE OF VISIT: <input type="text"/>	TIME IN: <input type="text"/>	TIME OUT: <input type="text"/>

SITE STATUS: Abandoned <input type="checkbox"/> Active <input type="checkbox"/>	UST's: Existing <input type="checkbox"/> Former <input type="checkbox"/>	SURFACE SOIL STAINING: Yes <input type="checkbox"/> No <input type="checkbox"/>
SURFACE WATER ON OR ADJACENT TO PROPERTY: Yes <input type="checkbox"/> No <input type="checkbox"/>		EXISTING MONITORING WELLS: Yes <input type="checkbox"/> No <input type="checkbox"/>
Existing Structures Including Dimensions and Use: <input type="text"/>		
Chemicals of Potential Concern: <input type="text"/>		
DRINKING WATER SOURCE: <input type="text"/>	SURROUNDING LAND USE: Residential <input type="checkbox"/> Commercial <input type="checkbox"/> Industrial <input type="checkbox"/>	
GW <input type="checkbox"/> Public <input type="checkbox"/> Other <input type="text"/>	Recreational <input type="checkbox"/> Agricultural <input type="checkbox"/> Other <input type="text"/>	
OTHER AREAS OF CONCERN: <input type="text"/>		

COMMENTS

Signature: Patty Hickman, Project Manager Date:
email address: phickman@wvdep.org

Charleston – Original

Copy – Project Manager

Copy - Applicant

Checklist for Risk Assessment Review

CHECKLIST FOR RISK ASSESSMENT REVIEW				
Name of site in ERIS				
Street Address		City	County	ZIP
Title of Document				
Date received by OER		Due Date of Response		
DEP Project Manager		Phone Number/Extension		
LRS		Phone		Email
Risk Assessor		Phone		Email
If draft of this document has been previously reviewed, please indicate:				
Date of prior review		Reviewer		
Date of prior review		Reviewer		
Date of prior review		Reviewer		
Site Assessment:	Yes	No	Comments or Concerns	
Is the site accurately described?				
1. Physical setting				
2. Notable geologic and hydrogeologic features				
3. Historical, current and future use of site				
4. Current and future land use adjacent to site				
5. Surrounding areas of ecological significance				
Is the site assessment complete?				
1. Potentially impacted media				
2. Potential source areas				
3. Potential offsite migration				
4. Use of appropriate analytical methods				
5. Field screening tools used appropriately				
Do data accurately represent site conditions?				
1. All relevant data presented and discussed				
2. Detection limits are at appropriate levels				
3. Sufficient samples have been collected				
4. Data quality objectives consistent with use				
5. Data validation performed as required				
Exposure Assessment	Yes	No	Comments or Concerns	
Has a Site Conceptual Model been submitted?				
1. All potential onsite receptors considered				
2. Offsite receptors included if necessary				
3. Future exposures consistent with land use				
4. Ecological receptors are addressed				
Are exposure point concentrations appropriate?				
1. Appropriate statistical analysis of site data				
2. Estimate based on fate and transport models				
Have all site contaminants been addressed?				
1. Compliance with de minimis standards				
2. Compliance with uniform risk based standard				
3. Compliance demonstrated by risk assessment				
4. Site contaminants below background				
Is Ecological Checklist completed correctly?				
1. Meet relevant ecological benchmarks				
Are institutional/engineering controls required?				
1. Deed restrictions or covenants				
2. Operation and maintenance agreements				
3. Health and safety plan				
Do you agree with the conclusions as presented?				
Additional comments:				
Date sent for risk assessment review		Requested completion date		
Date received for review		Review completion date		

VRA Project Status Checklist (1 of 3)

VOLUNTARY REMEDIATION PROGRAM

PROJECT STATUS CHECKLIST

Site Name:	<input type="text"/>
Location:	<input type="text"/>
Project#:	<input type="text"/>
Owner:	<input type="text"/>
LRS:	<input type="text"/>

1. Application is submitted.
Date: (60-3-4)
2. DEP reviews application. ☐ Approved ☐ Disapproved
Date: (45 day time frame)
3. Applicant submits application fee.
Date: (60-3-4.3)
4. The LRS and DEP Project Manager conduct a site visit.
Date:
5. Applicant executes a Voluntary Remediation Agreement with the DEP.
Date: (60-3-6)
6. The LRS sets up a Public Repository.
Date: (60-3-7.10.b)
7. The DEP publishes a summary of the Application.
Date: (6-3-7.9)
8. The DEP publishes a News Release.
Date: (60-3-7.9.i.1)
9. The LRS has submitted a Site Assessment Work Plan.
Date: (60-3-10)
10. The DEP submits a Cost Estimate to the LRS.
Date: (60 day time frame)

VRA Project Status Checklist (2 of 3)

-2-

1. The LRS submits the Site Assessment Report.
Date: .
12. The DEP submits a Cost Estimate to review SA Report.
Date: . (60 day time frame)
13. The DEP reviews SA Report and responds back to the LRS.
Date: . (30 day time frame)
14. The DEP submits a Cost Estimate to LRS for a site visit with the DEP risk assessment contractor, DEP, and the LRS.
Date: .
15. The LRS submits a Human Health Risk Assessment (RA).
Date: . (60-3-8)
16. The DEP submits a Cost Estimate for review of the RA.
Date: .
17. The DEP submits the Human Health RA review response to the LRS.
Date: . (30 day time frame)
18. The LRS submits an Ecological RA to the DEP.
Date: .
18. The DEP submits a Cost Estimate for review of the Ecological RA.
Date: .
20. The DEP submits an Ecological RA review response to the LRS.
Date: . (30 day time frame)
21. The LRS submits a Remedial Selection Report.
Date: . (60-3-9.8)
22. The DEP submits a cost Estimate.
Date: . (60 day time frame)
23. The DEP reviews the Remedial Selection Report and responds to the LRS.
Date: . (30 day time frame)
24. The LRS has published a Public Notice of the Remedial Selection.
[Items 24 and 25 only apply to sites that are considering remediation goals where the risk is greater than 1×10^{-6} , one in a million, for residential areas or 1×10^{-5} , one in one hundred thousand, for industrial areas.]
Date: . (60-3-7.12)

VRA Project Status Checklist (3 of 3)

-3-

25. The LRS responds to comments and sends a copy of responses to the DEP.
Date: . (30 day comment period)
26. Remedial Oversight Period.
Start Date: .
27. The DEP sends Cost Estimate to LRS for the Oversight Period.
Date: . (60 day time frame)
28. The LRS submits a Residual Risk Assessment.
Date: . (60-3-8.6)
29. The DEP submits a Cost Estimate.
Date: .
30. The DEP reviews the Residual RA.
Date: . (30 day time frame)
31. The LRS submits the Final Report.
Date: . (60-3-11)
32. The DEP submits a Cost Estimate.
Date: .
33. The DEP reviews Final Report.
Date: . (30 day time frame)
34. The LRS requests a Certificate of Completion.
Date: . (60-3-12)
35. The DEP issues a Certificate of Completion.
Date: . (60 day review time frame)

WVDEP OER Field Oversight Checklist - General Procedures

(Page 1 of 3)

Site Name:	
Location:	
Project #:	
Field Supervisor/Team	
Oversight Personnel	
Date(s) of Oversight	

Checklist section(s) completed for this overview:

1___ 2___ 3___ 4___

KEY:

1 General Procedures 2 Groundwater Sampling 3 Potable Water Sampling 4 Soil & Sediment Sampling

1) Type of samples collected? _____

2) Were sampling locations properly selected? Yes___ No___

Comments: _____

3) Were sampling locations adequately documented in a bound field log book using indelible ink? Yes___ No___

Comments: _____

4) Were photos taken and was a photo log maintained? Yes___ No___

5) What field instruments were used during? _____

6) Were field instruments properly calibrated and calibrations recorded in a bound field log book? Yes___ No___

Comments: _____

7) Was sampling equipment protected from possible contamination prior to sample collection? Yes___ No___

Comments: _____

8) Was sampling equipment constructed of Teflon®, polyethylene, glass, or stainless steel? Yes___ No___

Comments: _____

WVDEP OER Field Oversight Checklist - General Procedures

(Page 2 of 3)

9) Were samples collected in proper order? (least suspected contamination to most contaminated?) Yes ____ No ____

Comments: _____

10) Were clean disposable latex or vinyl gloves worn during sampling? Yes ____ No ____

Comments: _____

11) Were gloves changed before each sample? Yes ____ No ____

Comments: _____

12) Was any equipment field cleaned? Yes ____ No ____

Comments: _____

13) Type of equipment cleaned? _____

14) Were proper cleaning procedures used? Yes ____ No ____

Comments: _____

15) Were equipment rinse blanks collected after field cleaning? Yes ____ No ____

Comments: _____

16) Were proper sample containers used for samples? Yes ____ No ____

Comments: _____

17) Were split samples offered to the regulatory agency representative? Yes ____ No ____

Comments: _____

18) Was a receipt for samples form given to regulatory agency representative? Yes ____ No ____

Comments: _____

19) Were any duplicate samples collected? Yes ____ No ____

Comments: _____

20) Were samples properly field preserved? Yes ____ No ____

Comments: _____

21) Were preservative blanks utilized? Yes ____ No ____

Comments: _____

WVDEP OER Field Oversight Checklist - General Procedures

(Page 3 of 3)

22) Were field and/or trip blanks utilized? Yes_____ No_____

Comments: _____

23) Were samples adequately identified with labels? Yes_____ No_____

Comments: _____

24) Were coolers sealed with custody seals after collection? Yes_____ No_____

Comments: _____

25) Were security measures were taken to insure custody of the samples after collection? Yes_____ No_____

Comments: _____

26) Were chain-of-custody and receipt for samples forms properly completed? Yes_____ No_____

Comments: _____

27) Were any samples shipped to a laboratory? Yes_____ No_____

Comments: _____

28) If yes to No. 27, were samples properly packed? Yes_____ No_____

Comments: _____

29) What safety monitoring equipment, protection, and procedures were used prior to and during sampling?

30) Was safety equipment properly calibrated and were calibrations recorded in a bound log book? Yes_____ No_____

Comments: _____

Additional Comments: _____

WVDEP OER Field Oversight Checklist – Groundwater Sampling

(Page 1 of 3)

- 1) Type of wells sampled? (monitoring, potable, industrial, etc.) _____
- 2) Were wells locked and protected? Yes _____ No _____
Comments: _____
- 3) Were identification marks and measurement points affixed to the wells? Yes _____ No _____
Comments: _____
- 4) What were the sizes and construction materials of the well casings? Yes _____ No _____
Comments: _____
- 5) Were the boreholes sealed with a concrete pad to prevent surface infiltration? Yes _____ No _____
Comments: _____
- 6) Was there a dedicated pump in the well? Yes _____ No _____
Comments: _____
- 7) Was clean plastic sheeting placed around the wells to prevent contamination of sampling equipment and containers? Yes _____ No _____
Comments: _____
- 8) Were total depth and depth to water determined before purging? Yes _____ No _____
Comments: _____
- 9) What device was used to determine depth? _____
- 10) Were measurements made to the nearest 0.01 ft.? Yes _____ No _____
Comments: _____
- 11) Was the measuring device properly decontaminated between wells? Yes _____ No _____
Comments: _____
- 12) Was the standing water volume in each well determined? Yes _____ No _____
Comments: _____
- 13) How was the volume determined? _____
- 14) Was a sufficient volume purged prior to sampling? Yes _____ No _____
Comments: _____

WVDEP OER Field Oversight Checklist – Groundwater Sampling

(Page 2 of 3)

15) What was done with the purged water? Was it collected for proper disposal, containerized until characterized or sent to an approved treatment facility? Yes _____ No _____

Comments: _____

16) How many volumes? _____

17) How was the purged volume measured? _____

18) What was the method of purging? _____

19) Were pH, conductivity, temperature, turbidity, and dissolved oxygen (DO) measurements taken and recorded during well-purging activities? Yes _____ No _____

Comments: _____

20) Were pH, conductivity, temperature, turbidity, and DO readings stable prior to sampling? Yes _____ No _____

Comments: _____

21) How many wells were sampled? _____

Up gradient? _____ Down gradient? _____

Comments: _____

22) How were the samples collected? _____

23) If pump was used, what type? _____

24) If a pump was used, was it properly cleaned before and/or between wells? Yes _____ No _____

Comments: _____

25) What were the decontamination procedures? _____

26) Was a new bailer or decontaminated pump used at each well? Yes _____ No _____

Comments: _____

27) Were samples properly transferred from the sampling device to the sample containers?
(i.e., purgeable sample first - not aerated, etc.) Yes _____ No _____

Comments: _____

28) Was pH of preserved samples checked to insure proper preservation? Yes _____ No _____

Comments: _____

WVDEP OER Field Oversight Checklist – Groundwater Sampling

(Page 3 of 3)

29) Were samples iced immediately after collection? Yes _____ No _____

Comments: _____

30) For what analyses were the samples collected? _____

31) If samples were split, what were the sample numbers for these? _____

Additional Comments: _____

WVDEP OER Field Oversight Checklist – Potable Water Sampling
(Page 1 of 2)

- 1) Did the sampler verify that the sample tap was not located after a household purification and/or conditioning system? Yes _____ No _____
Comments: _____
- 2) Were name(s) of the resident or water-supply owner/operator, mailing address, and phone number obtained by the field sampling team? Yes _____ No _____
Comments: _____
- 3) Was clean plastic sheeting placed around the sampling point to prevent contamination of sampling equipment and containers? Yes _____ No _____
Comments: _____
- 4) What were the preparatory purging procedures? _____

- 5) Were aerator, strainer, and hose attachments removed from the tap prior to sampling? Yes _____ No _____
Comments: _____
- 6) Were pH, specific conductance, and temperature readings stable prior to sampling? Yes _____ No _____
Comments: _____
- 7) Were the samples collected directly into the sample container? Yes _____ No _____
Comments: _____
- 8) Were clean gloves used for each sampling location? Yes _____ No _____
Comments: _____
- 9) How many taps were sampled? _____
- 10) If analyzing for dissolved metals, were the samples filtered in the field prior to preservation? Yes _____ No _____
Comments: _____
- 11) Was pH of preserved samples checked to insure proper preservation, and was this check completed without contaminating the sample? (i.e. do not put pH test strip into sample container) Yes _____ No _____
Comments: _____

WVDEP OER Field Oversight Checklist – Potable Water Sampling

(Page 2 of 2)

12) Were samples immediately placed in a cooler on ice after collection? Yes _____ No _____

Comments: _____

13) For what analyses were the samples collected? _____

14) If samples were split, what were the sample numbers? _____

Additional Comments: _____

WVDEP OER Field Oversight Checklist – Soil and Sediment Sampling

(Page 1 of 4)

1) Type of samples collected? _____

2) General description of samples? _____

3) How many samples were collected? _____

4) Were background and/or control samples collected? Yes _____ No _____

Comments: _____

5) Were representative samples collected? Yes _____ No _____

Comments: _____

6) Were grab or composite samples collected? _____

7) How many aliquots were taken for the composite sample? _____

8) What procedures and equipment were used to collect samples? _____

9) Was SW-846 method 5035 used for sample collection of volatile organics? (if so, complete questions 23-27 for the En Core sampling method or questions 28-36 for the Terra Core method) Yes _____ No _____

Comments: _____

10) Were composite samples thoroughly mixed prior to putting them into the sample containers? Yes _____ No _____

Comments: _____

11) Were samples properly placed into sample containers? Yes _____ No _____

Comments: _____

12) Were samples placed in a cooler on ice immediately after collection? Yes _____ No _____

Comments: _____

13) For what analyses were the samples collected? _____

WVDEP OER Field Oversight Checklist – Soil and Sediment Sampling

(Page 2 of 4)

14) If samples were split, what were the sample numbers for these? _____

15) Was a drilling rig, GeoProbe, back hoe, etc., used to collect soil samples? Yes _____ No _____

Comments: _____

16) What was done with the soil cuttings from the drill rig, GeoProbe or back hoe and were the cuttings collected for proper disposal, or containerized until characterized? Yes _____ No _____

Comments: _____

17) Were the drilling rig, GeoProbe, backhoe, etc., properly cleaned prior to arriving on site? Yes _____ No _____

Comments: _____

18) What was the condition of the drilling and sampling equipment when it arrived on site? (cleanliness, leaking jacks, peeling paint) _____

19) Was a decontamination area located where the cleaning activities would not cross-contaminate clean and/or drying equipment? Yes _____ No _____

Comments: _____

20) Was clean equipment properly wrapped and stored in a clean area? Yes _____ No _____

Comments: _____

21) Was the drilling rig(s) properly cleaned between well borings? Yes _____ No _____

Comments: _____

22) Were the cleaning/decontamination procedures conducted in accordance with the project plans? Yes _____ No _____

Comments: _____

Additional Comments: _____

WVDEP OER Field Oversight Checklist – Soil and Sediment Sampling
(Page 3 of 4)

EN CORE

23) Prior to sampling with the En Core was the coring body locked in place? Yes _____ No _____

Comments: _____

24) Was the coring body completely filled? Yes _____ No _____

Comments: _____

25) After sample collection was the coring body capped, placed in a sealed bag, labeled, and placed on ice? Yes _____ No _____

Comments: _____

26) Was sampling time recorded? Yes _____ No _____

Comments: _____

27) Were arrangements made with the lab to analyze Encore samples within 48 hours? Yes _____ No _____

Comments: _____

TERRA CORE

28) Was the balance used calibrated prior to use in the field? Yes _____ No _____

Comments: _____

29) Was the balance protected from the weather to ensure accurate weights are obtained? Yes _____ No _____

Comments: _____

30) Prior to adding solid to any vial, was the individual vial weight field checked using a balance (unless the vials were weighed or weight checked in the laboratory 24 hours before sample collection)? Yes _____ No _____

Comments: _____

31) Did the vial weight with preservative within +/- 0.2 g of the recorded lab weight? Yes _____ No _____

Comments: _____

32) If the weight obtained on the portable balance in the field differs from the laboratory weight (marked on the vial) by +/- 0.2 g, was the vial returned to the laboratory for proper disposal. Yes _____ No _____

Comments: _____

WVDEP OER Field Oversight Checklist – Soil and Sediment Sampling
(Page 4 of 4)

33) Was the coring body completely filled? Yes_____ No_____

Comments: _____

34) Was the soil transferred to the vial without losing preservative in the vial? Yes_____ No_____

Comments: _____

35) Was the weight of the vial, preservative, and added soil recorded to the nearest tenth of a gram? Yes_____ No_____

Comments: _____

36) Was the vial placed in a cooler on ice? Yes_____ No_____

Comments: _____

Additional Comments: _____
